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(58) Field of search

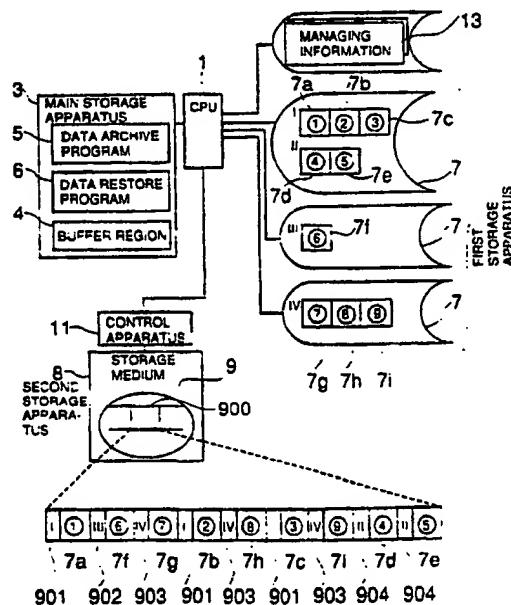
UK CL (Edition K) G4A AMG2 AMX
INT CL⁵ G06F, G11B

INT CL: G06F, G11B

(54) Data storage control

(57) A storage control method and an apparatus, including a buffer 4 for saving in second storage apparatus 8 (e.g. for back-up) a series of data which have been separately stored in a plurality of first storage apparatuses 7, are disclosed. Data blocks of a predetermined size are read into the buffer 4 from each of the first storage apparatuses 7 in a parallel mode. To each of the data blocks an identifier is added which specifies a position, within the first storage apparatuses 7, at which this data was stored. The identifier may also specify a sequential relation in a series of data being stored in the buffer 4. The data from the buffer is stored in the second storage apparatus 8 together with the identifiers. A series of data are restored together with their sequential relation from the second storage apparatus 8 by reference to the identifiers.

FIG. 1



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FIG. 1

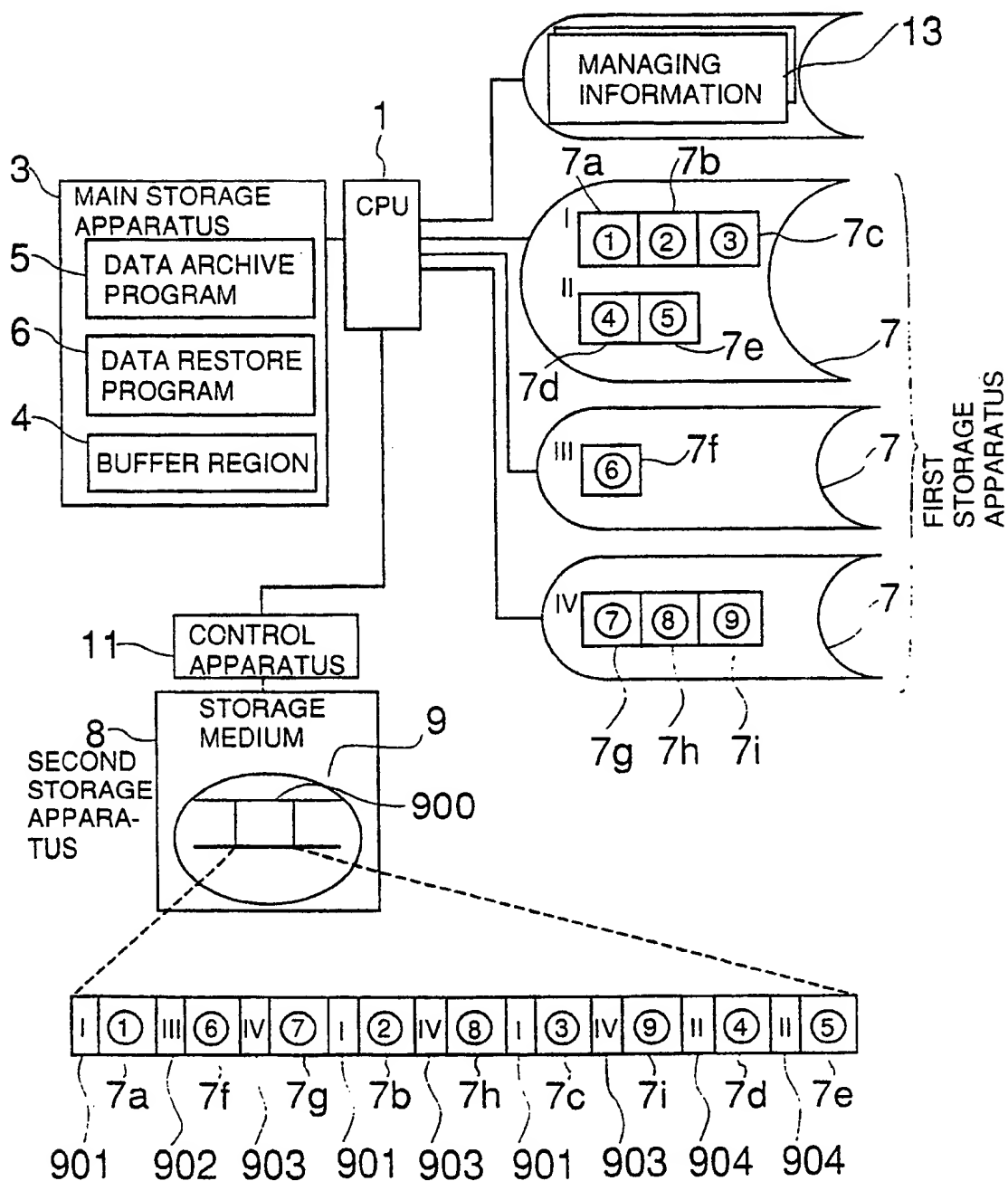


FIG. 2

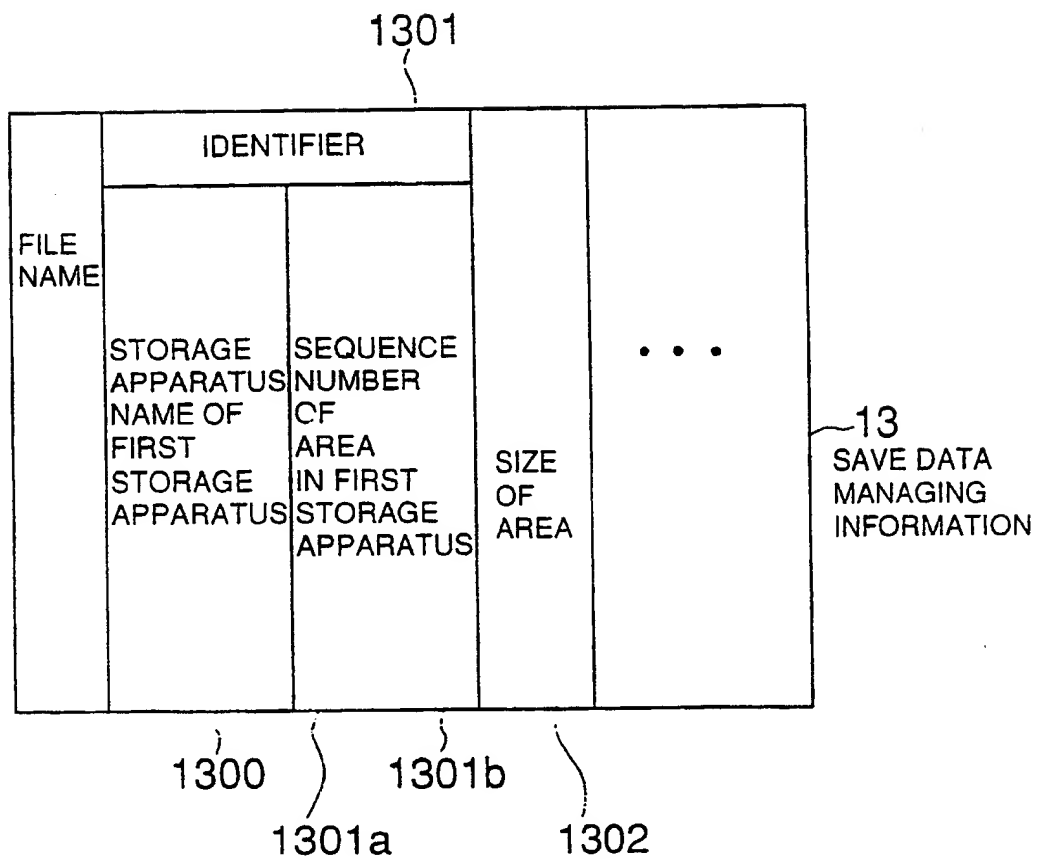


FIG. 3

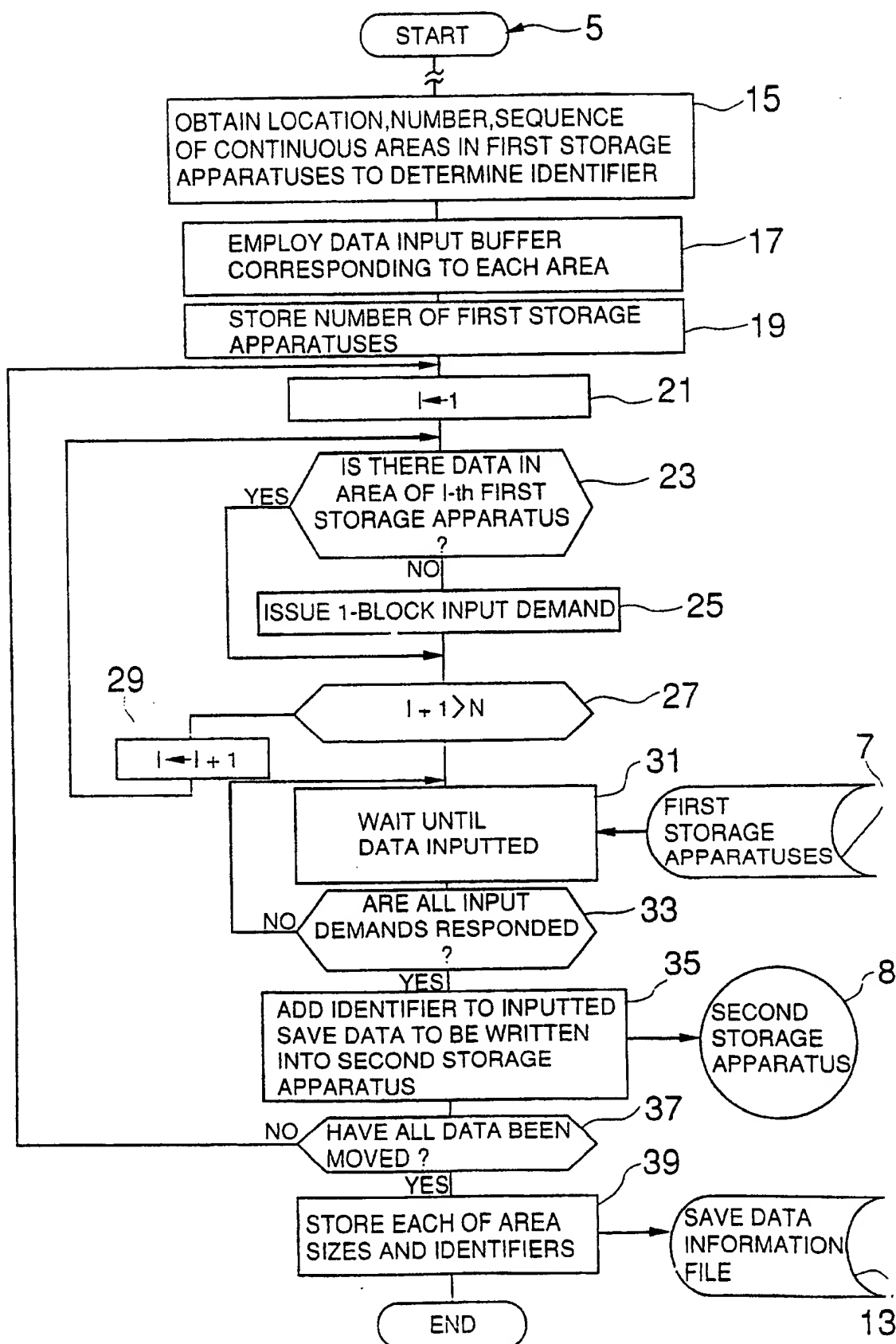


FIG. 4

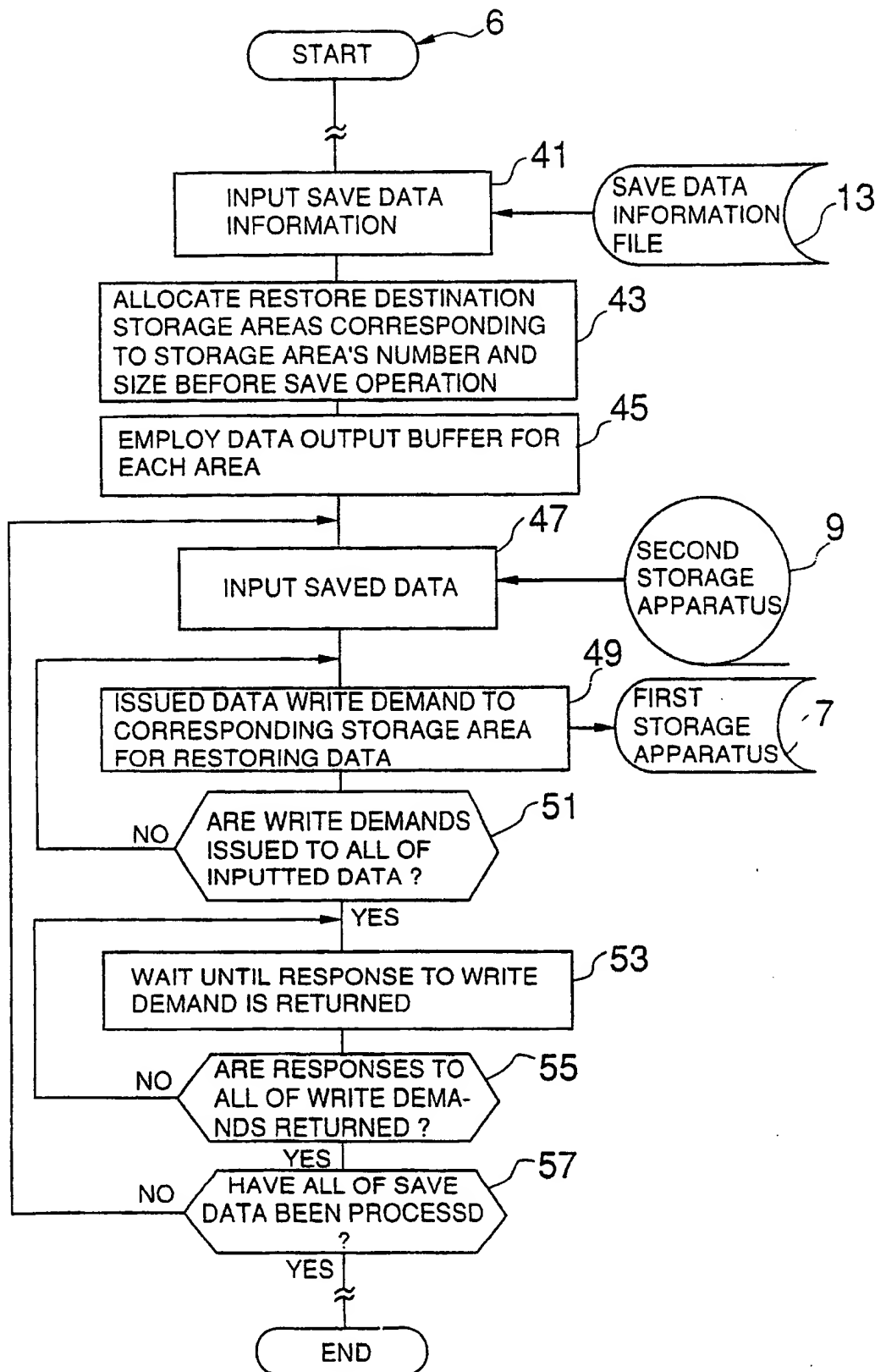


FIG. 5

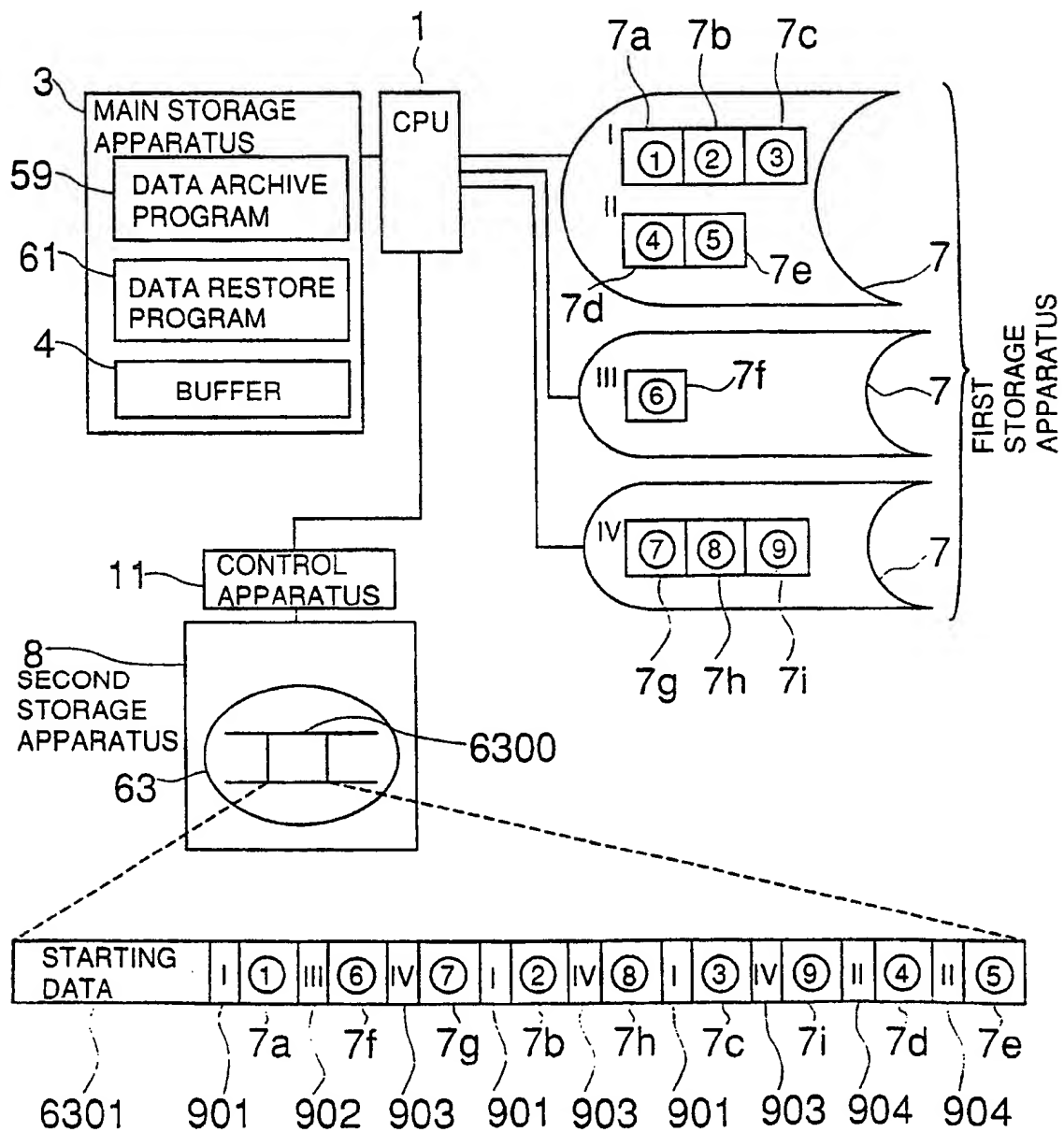


FIG. 6

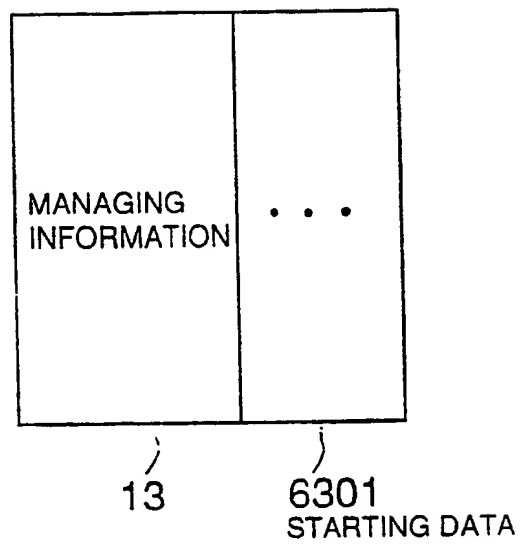


FIG. 7

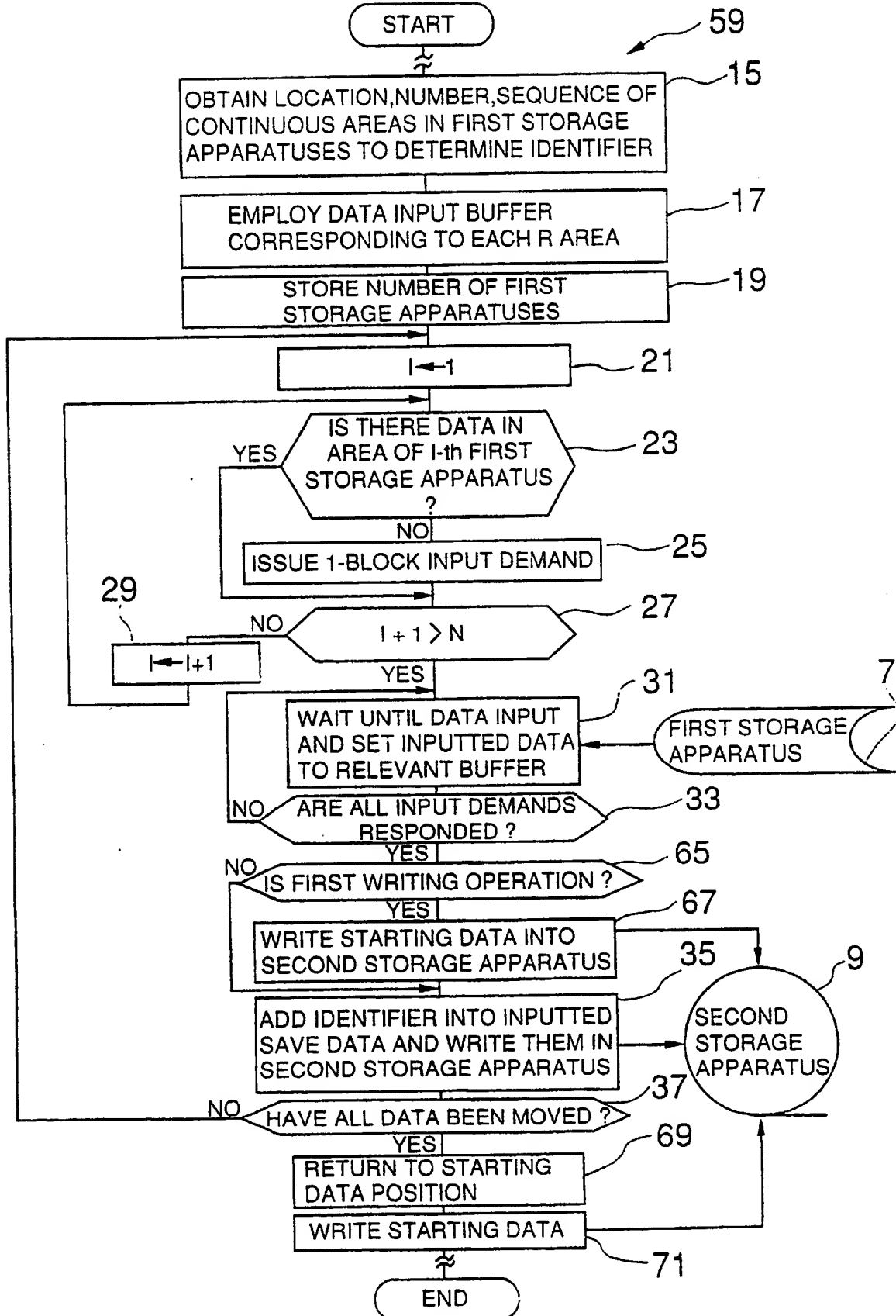


FIG. 8

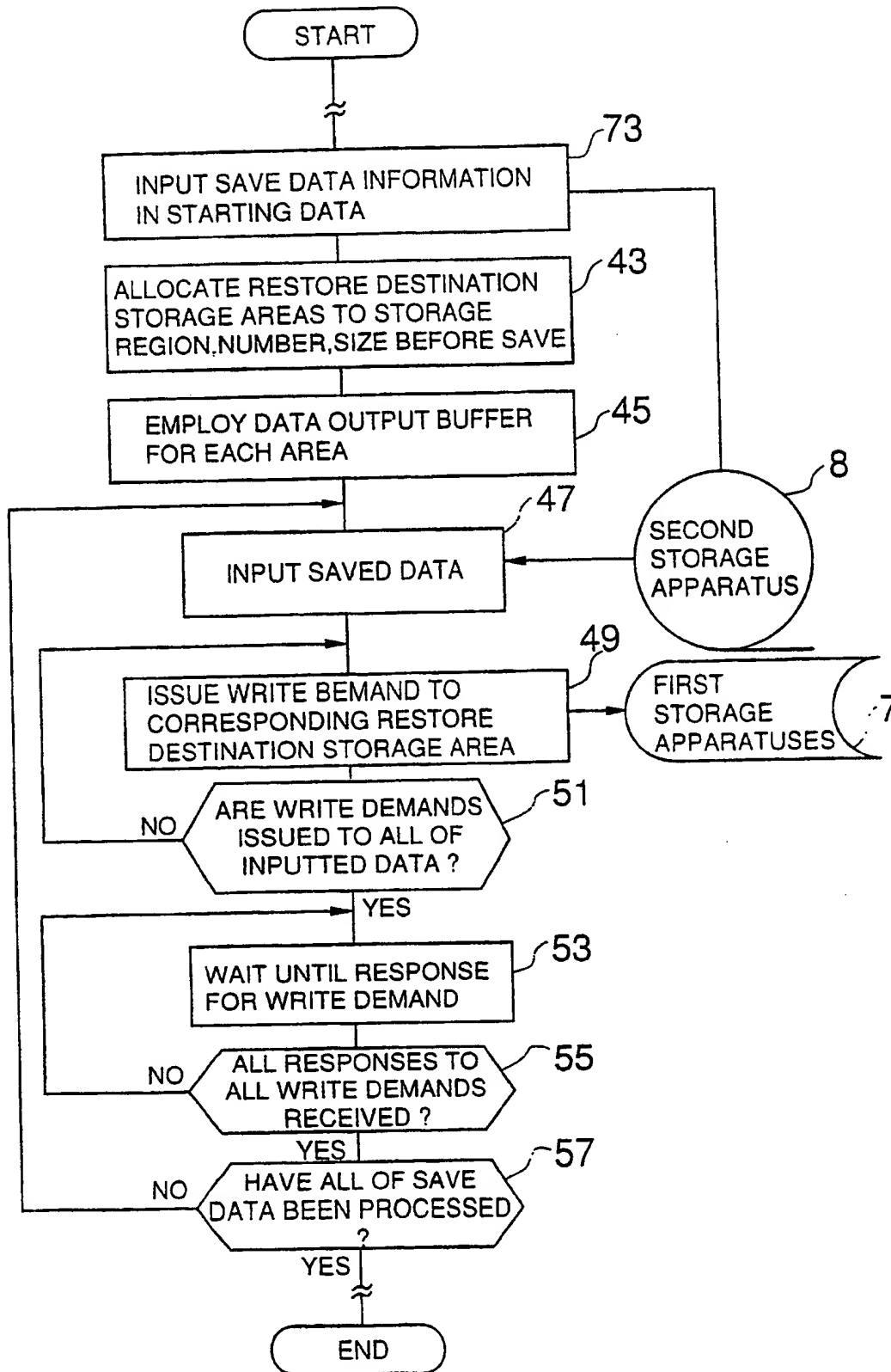


FIG. 9

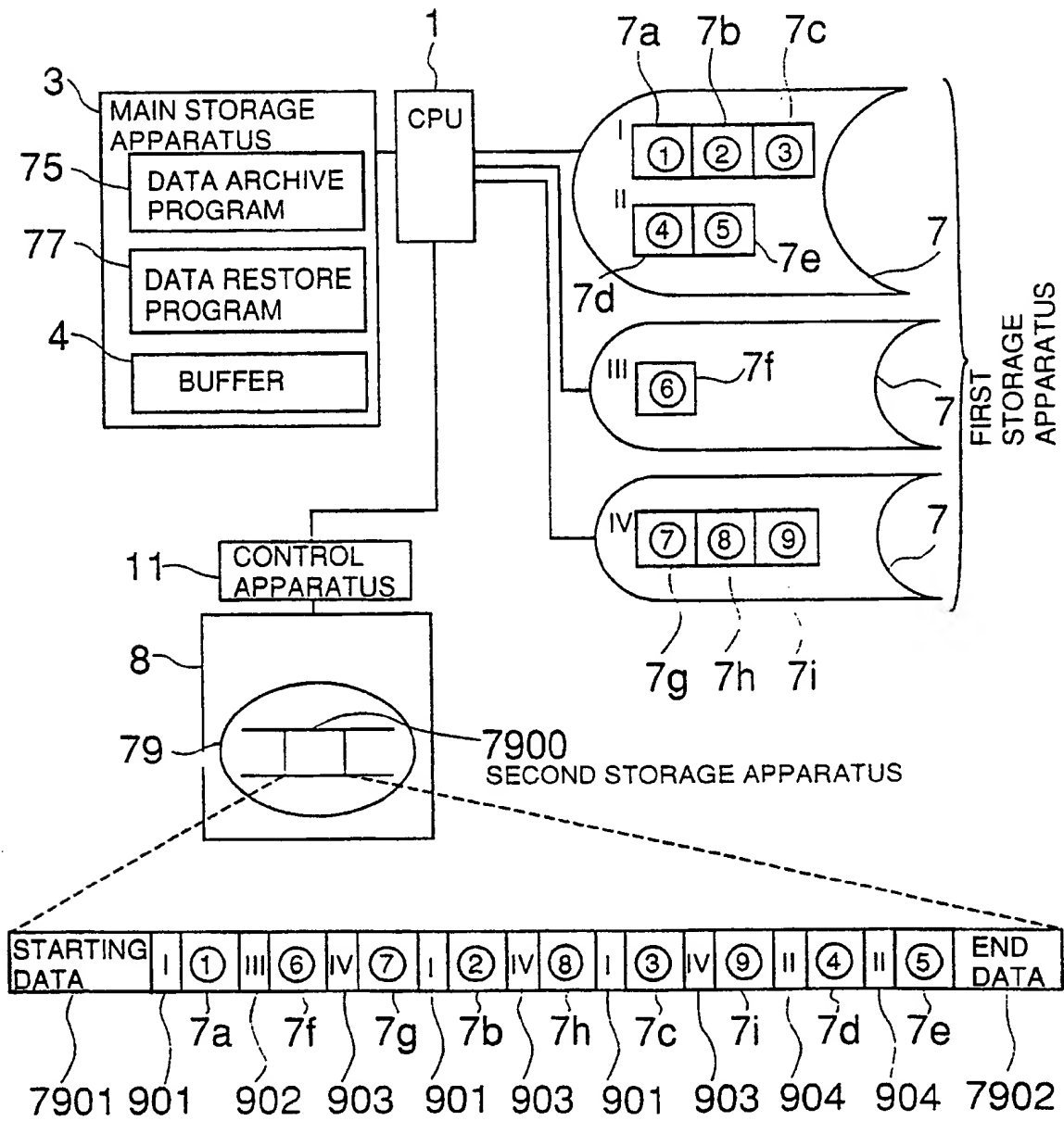


FIG. 10

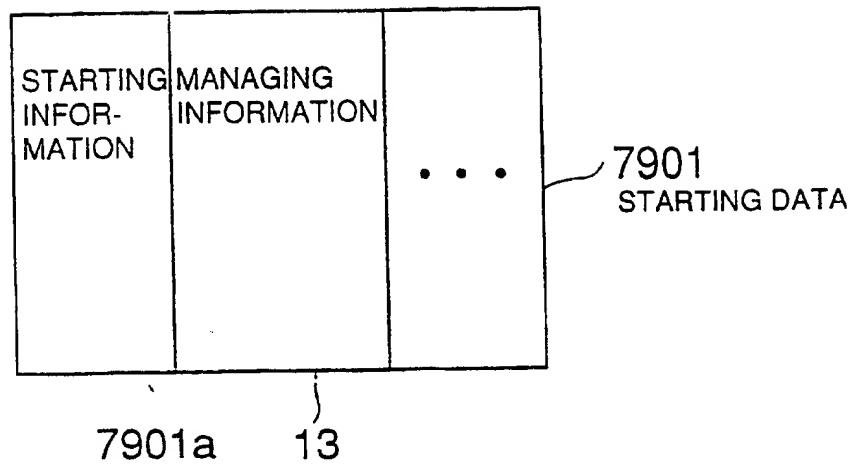
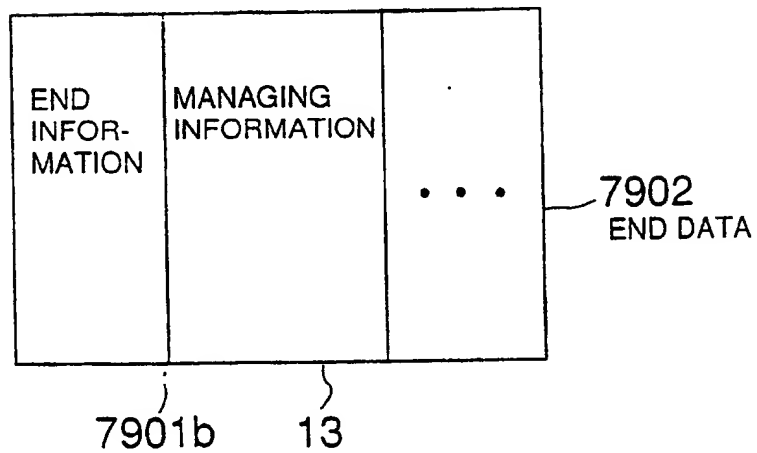


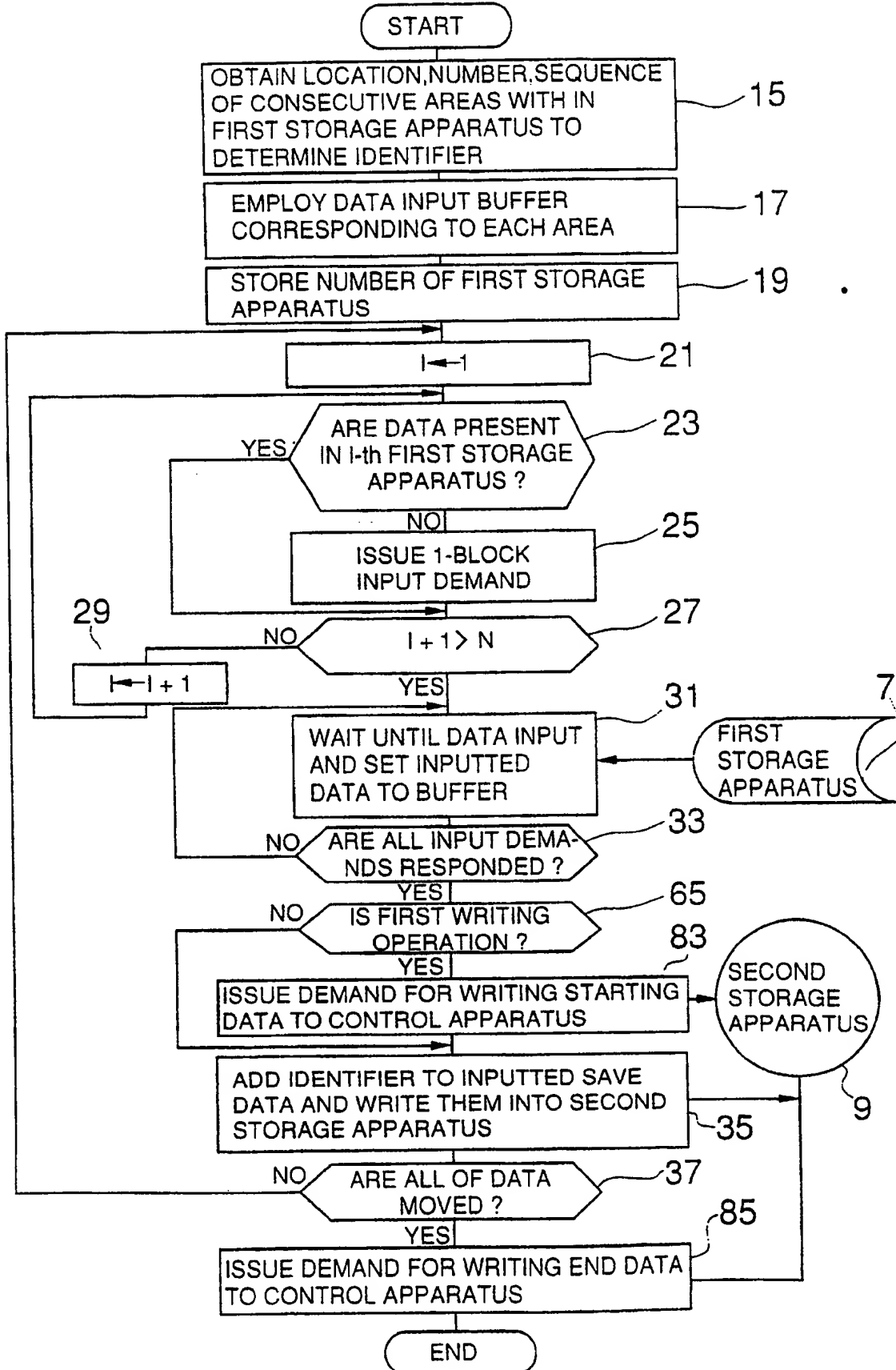
FIG. 11



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FIG. 12



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FIG. 13

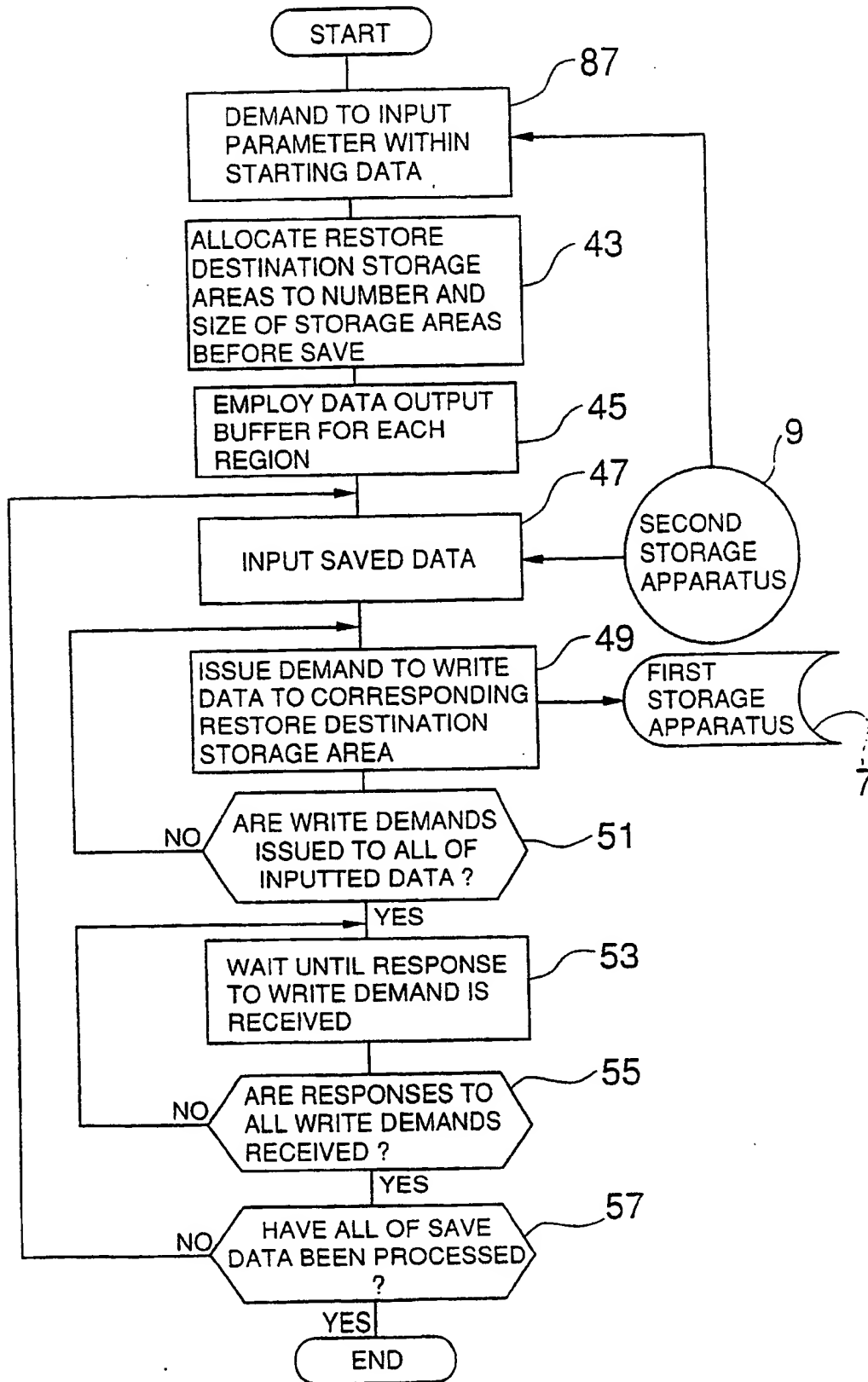
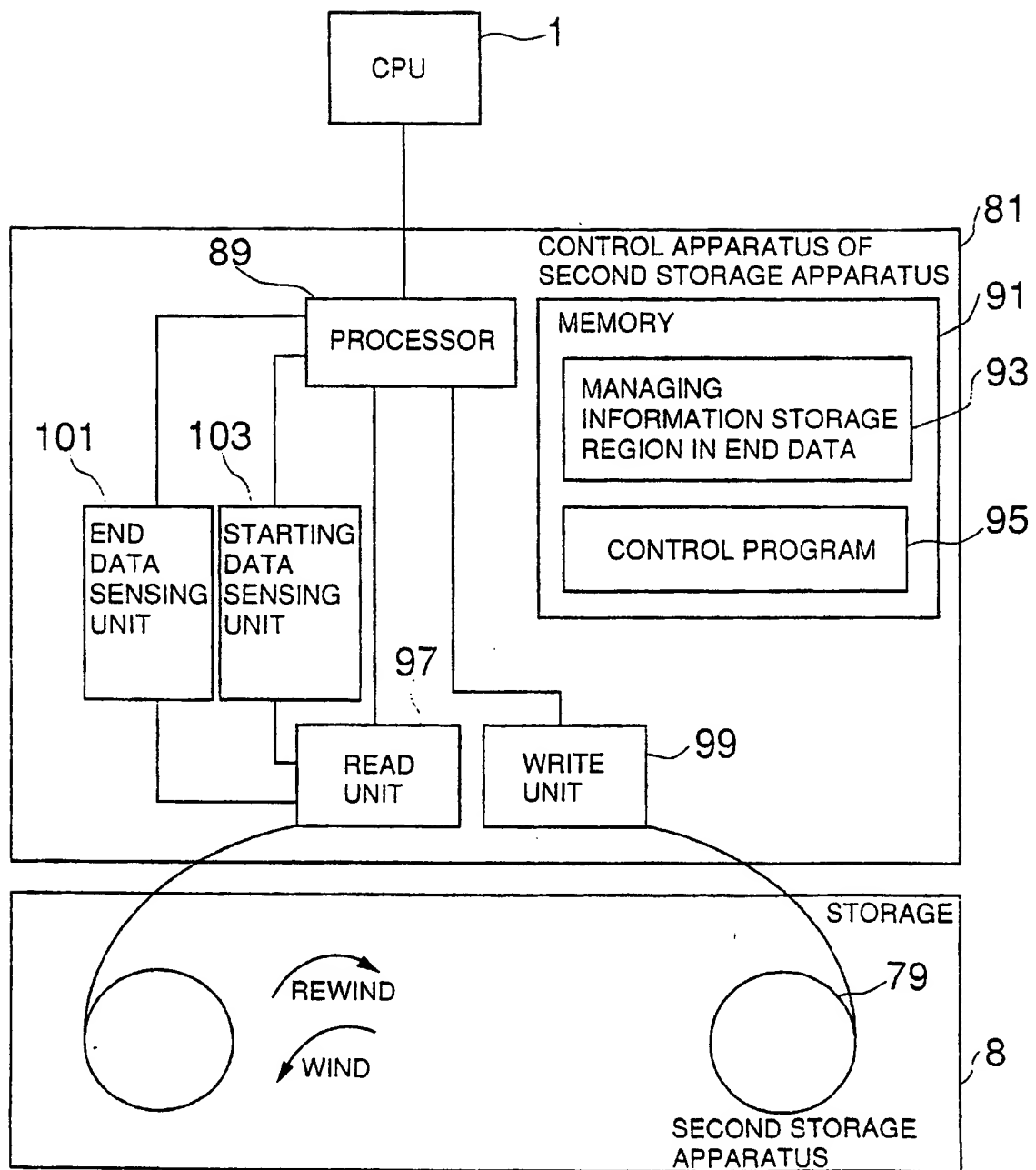


FIG. 14



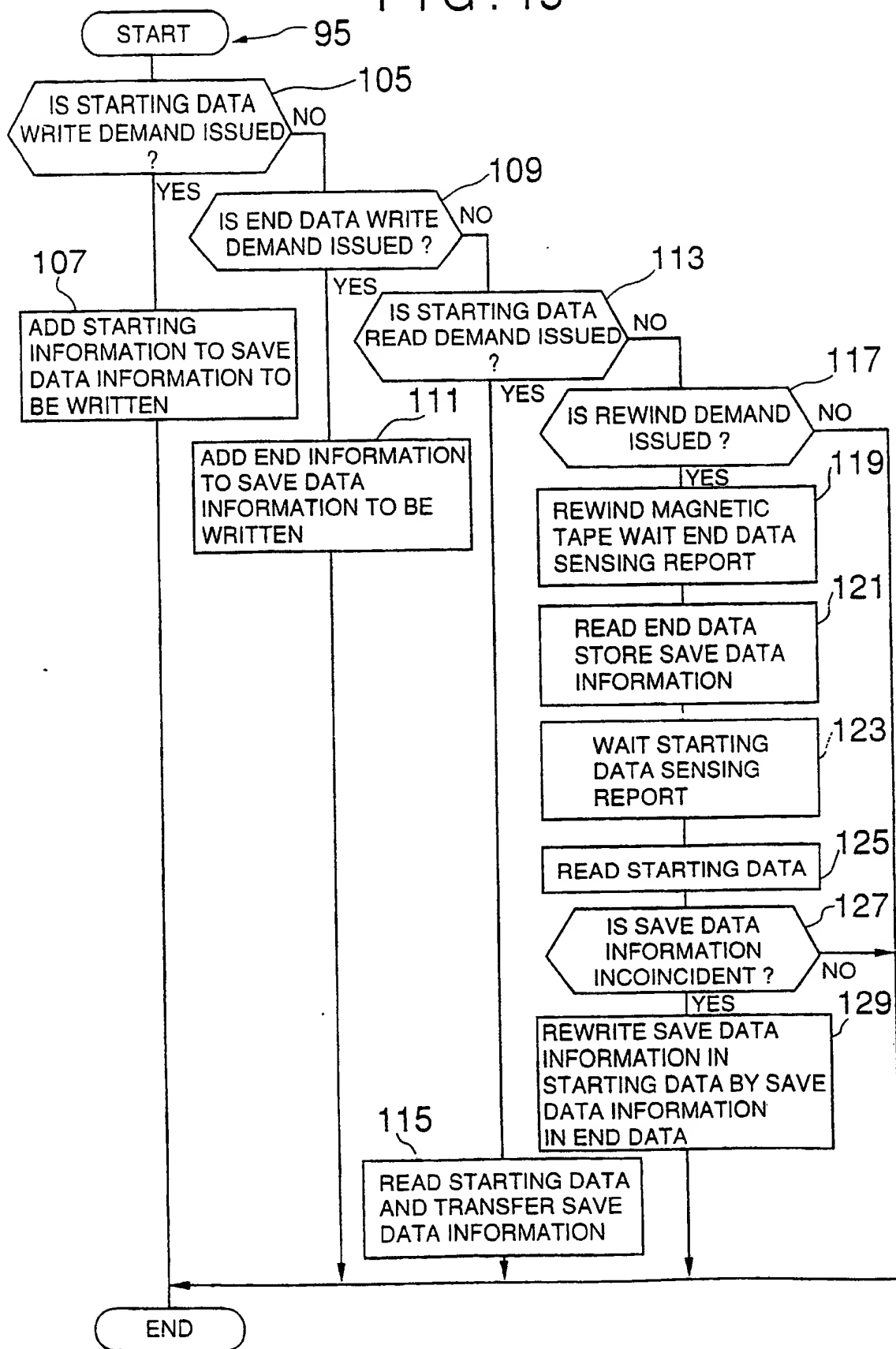


FIG. 16

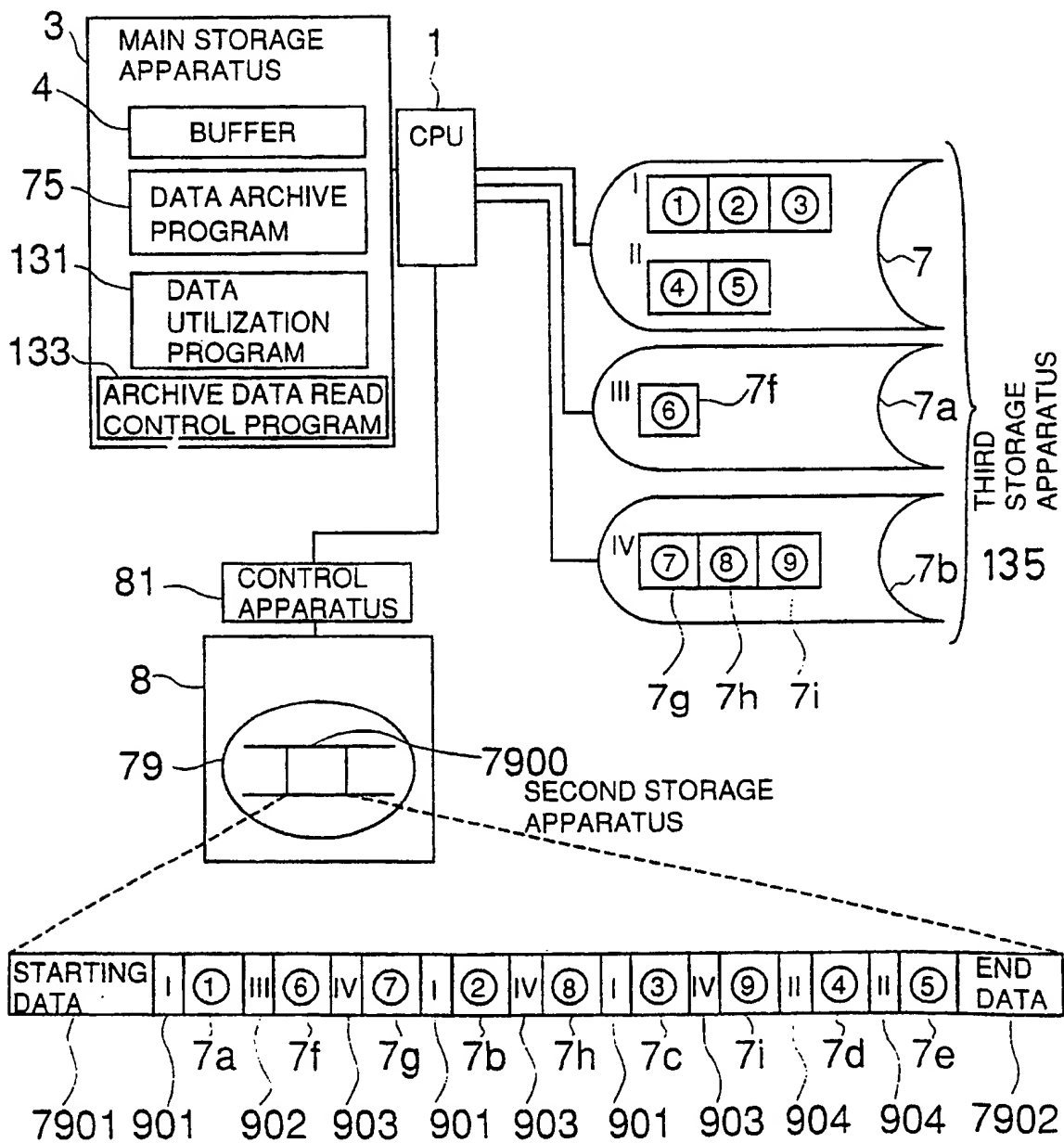


FIG. 17

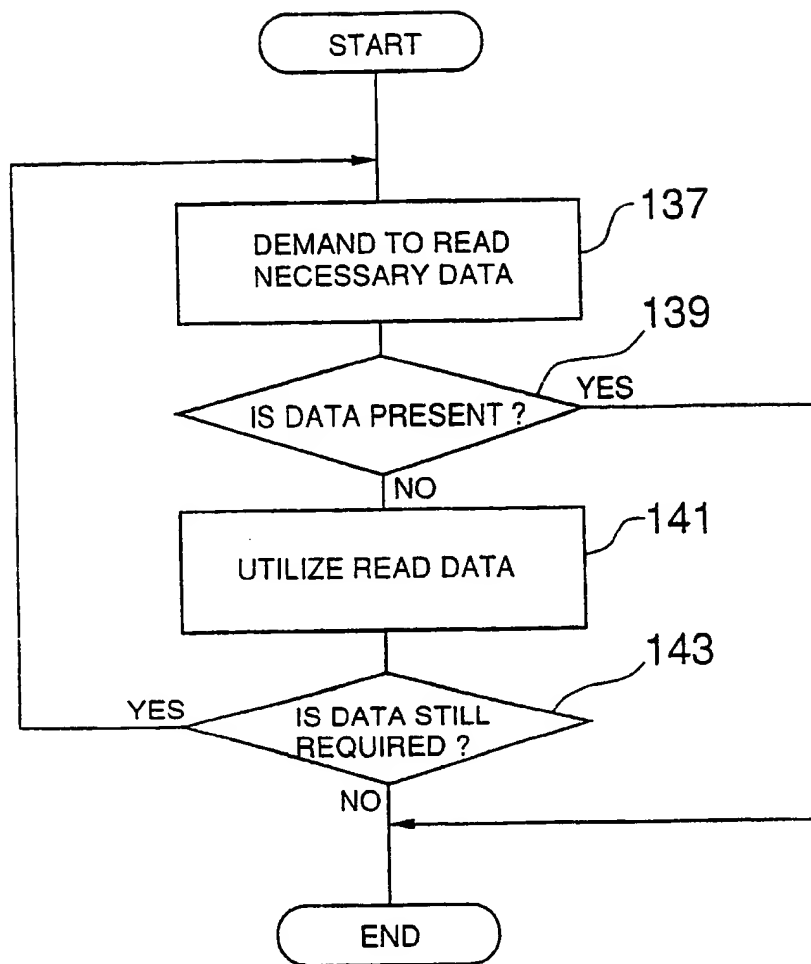


FIG. 18

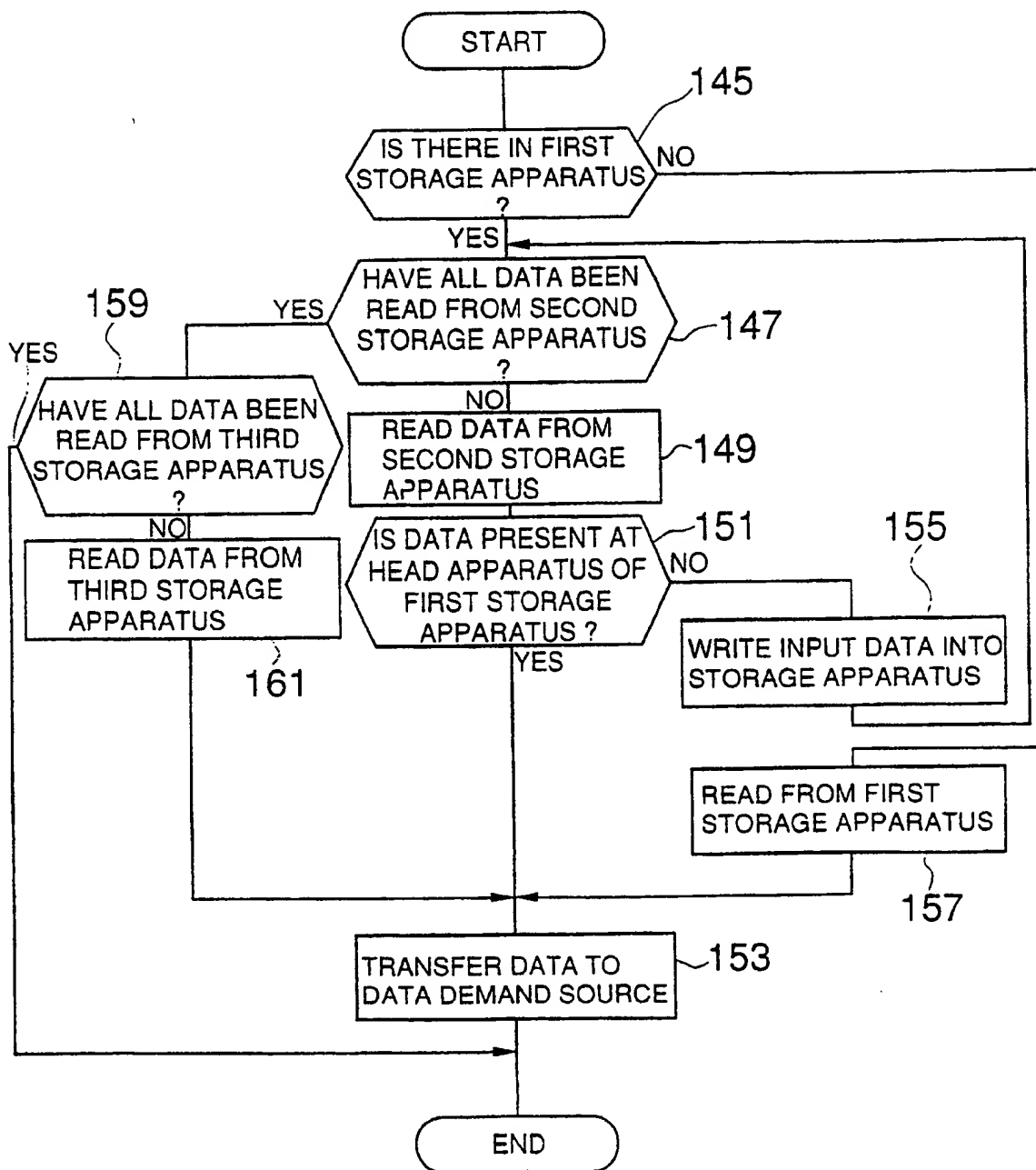


FIG. 19

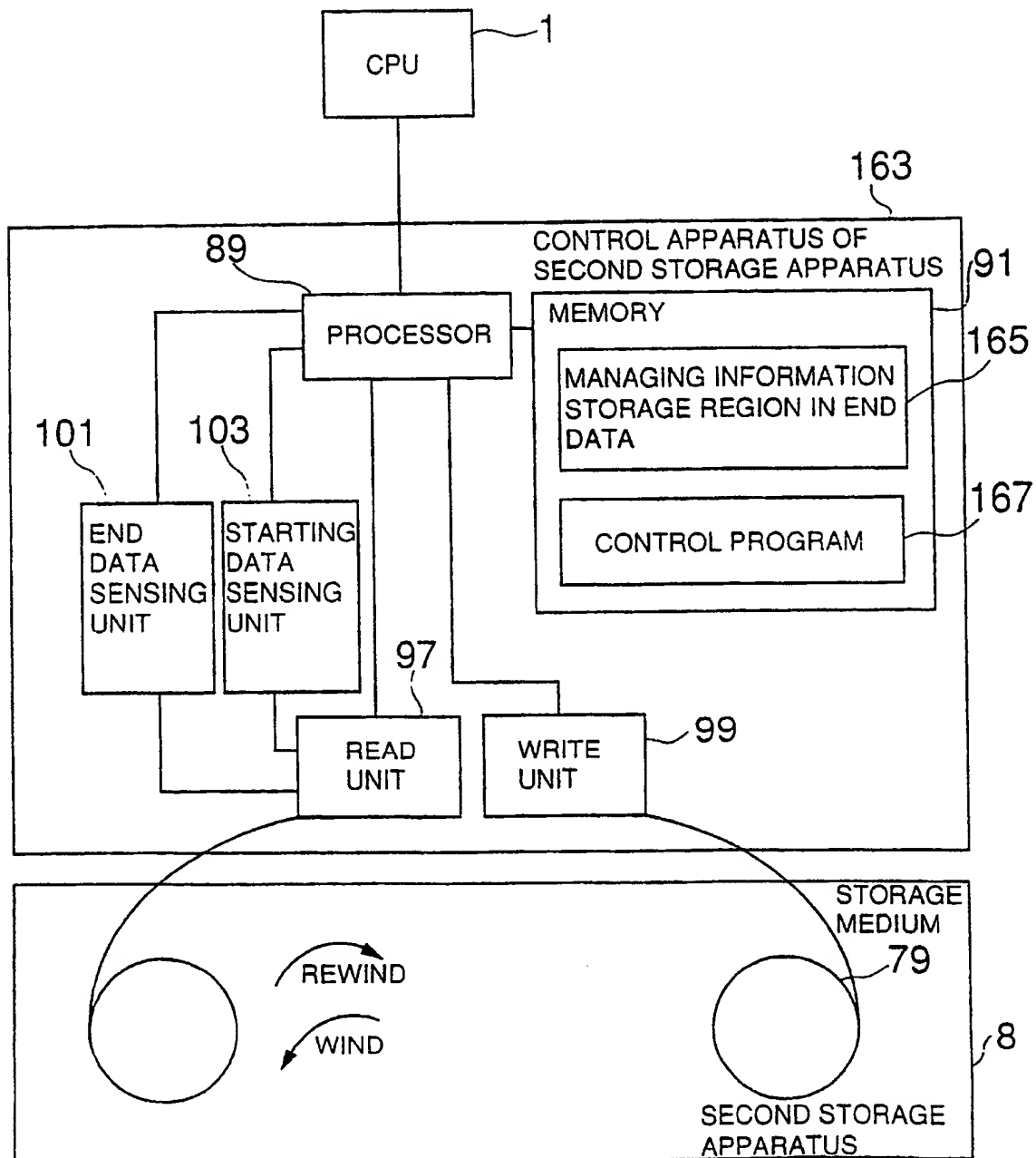


FIG. 20

(a)

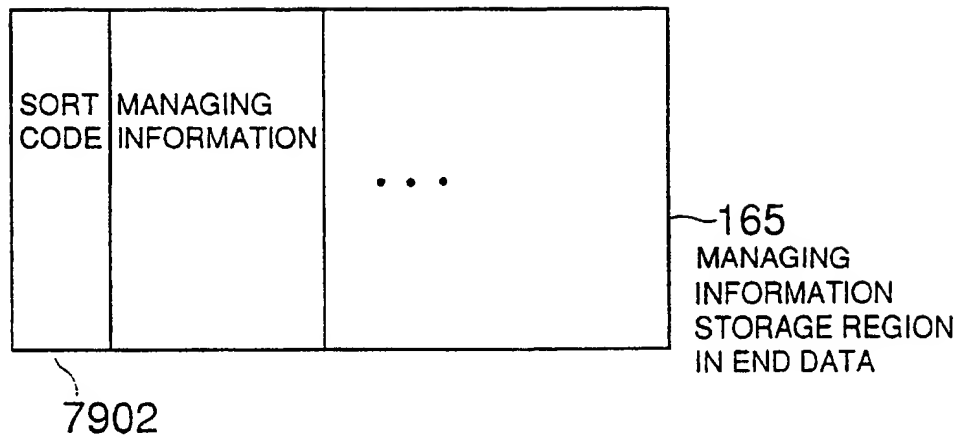


FIG. 20

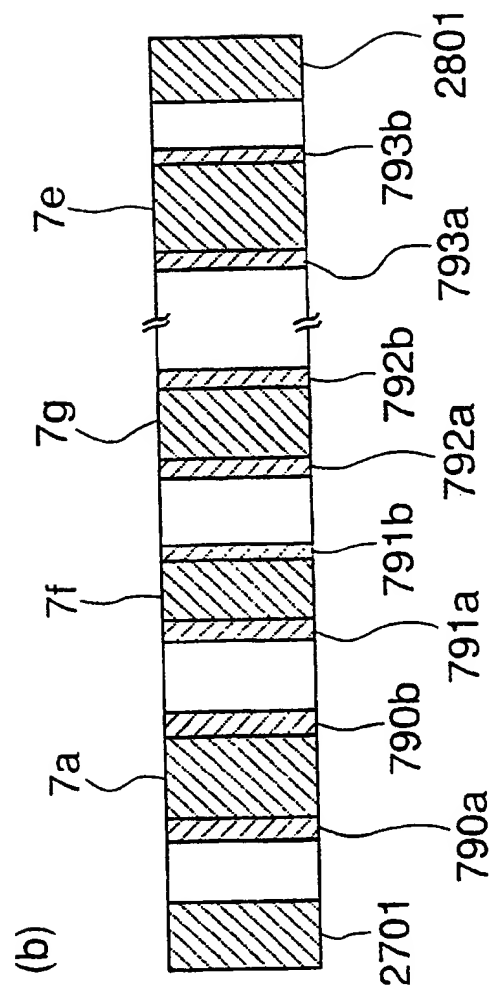


FIG. 21

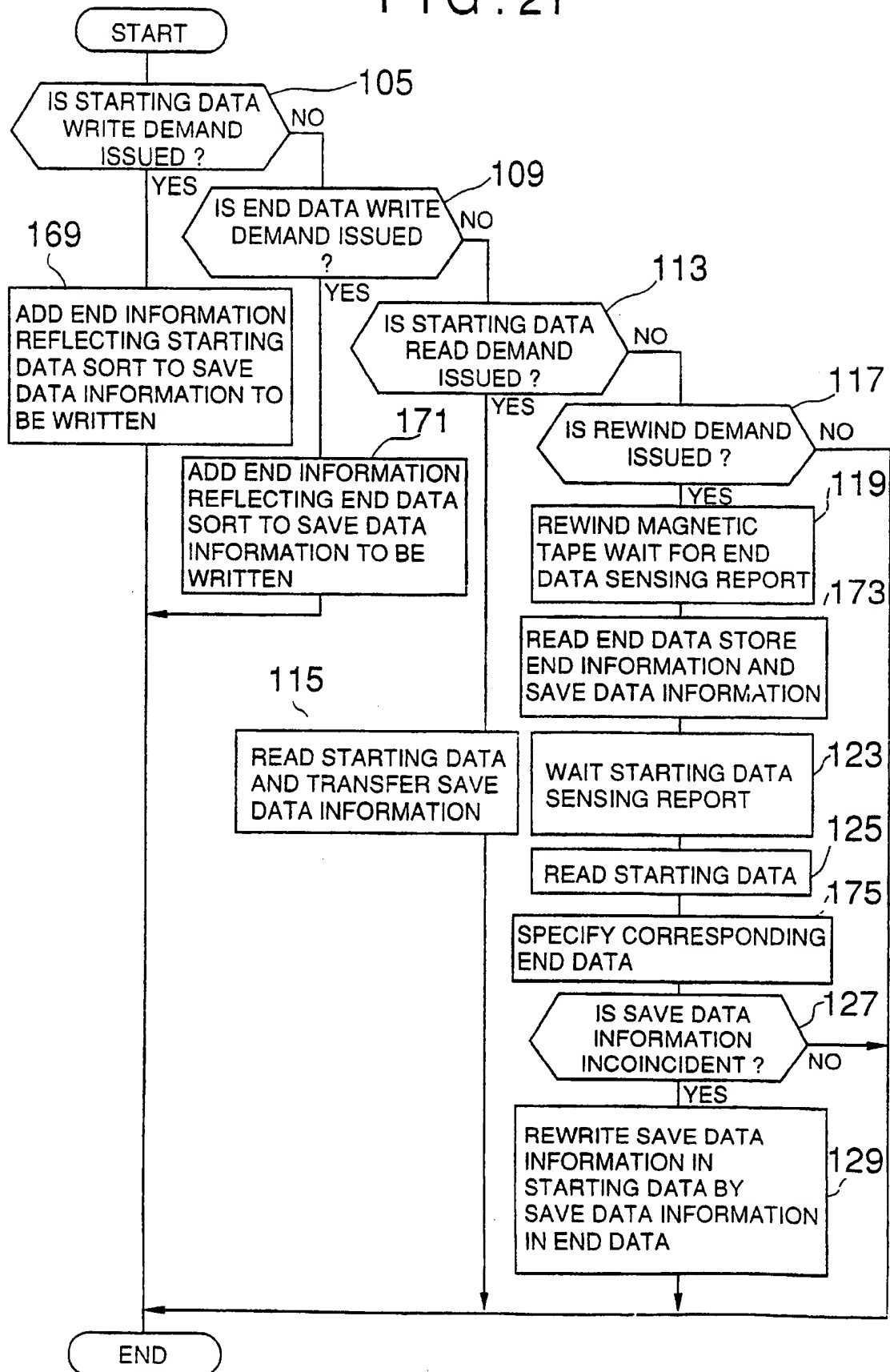


FIG. 22

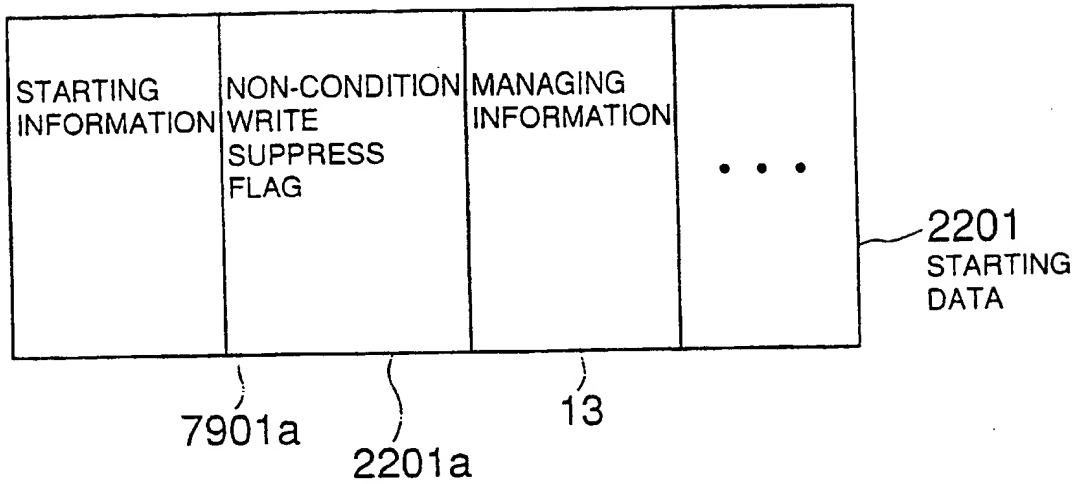


FIG. 23

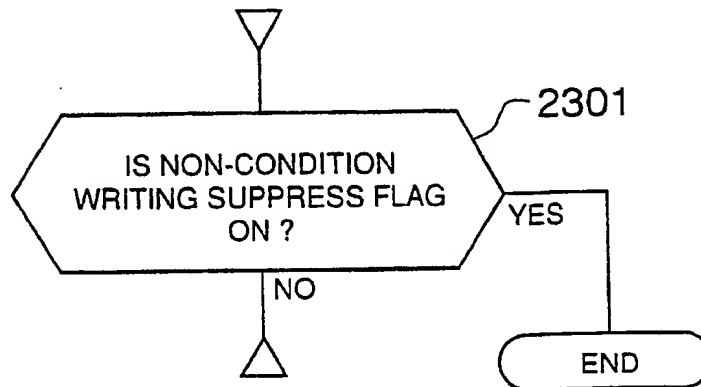


FIG. 24

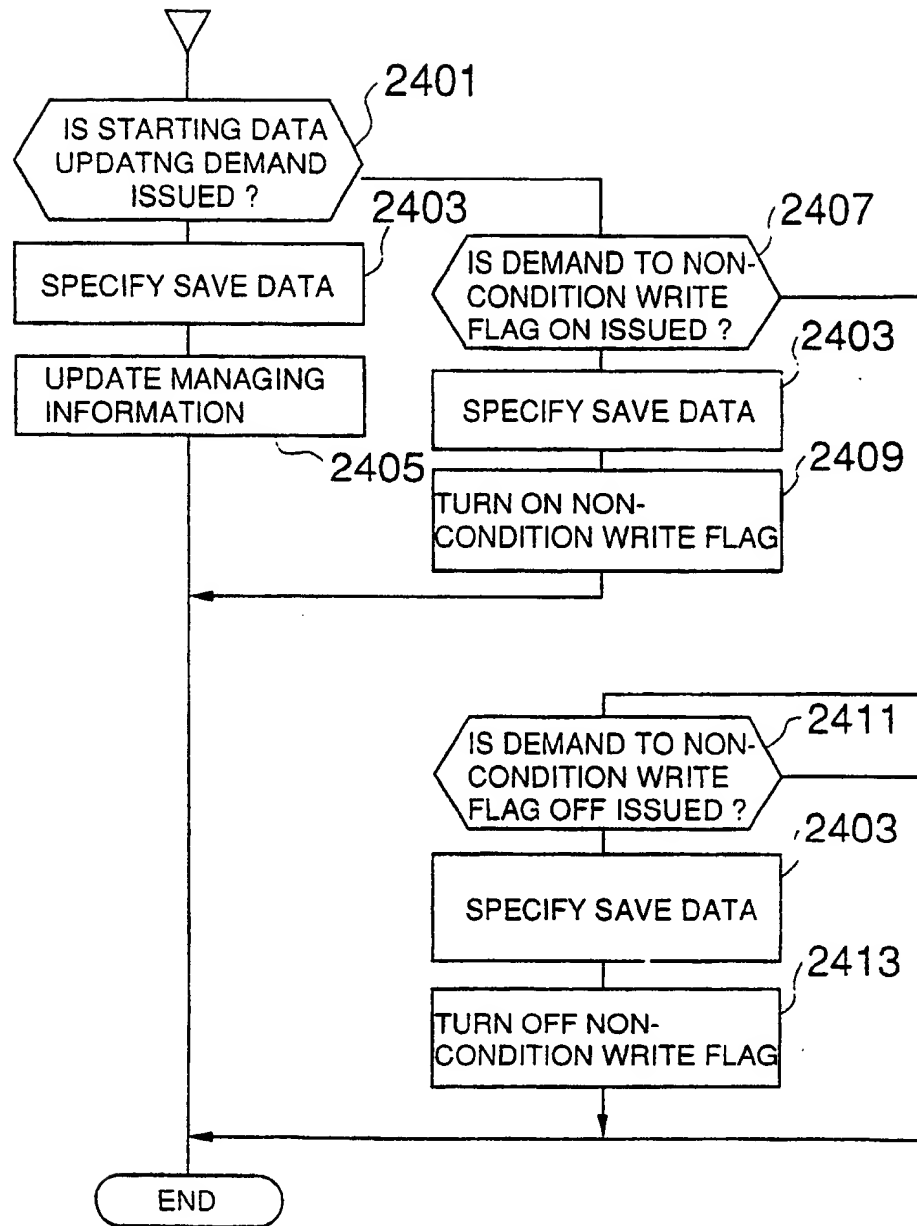


FIG. 25

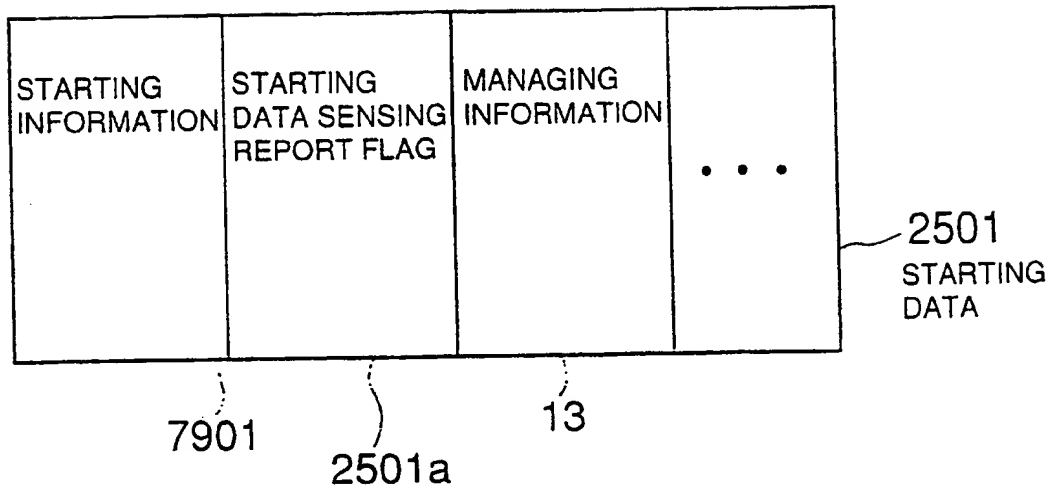


FIG. 26

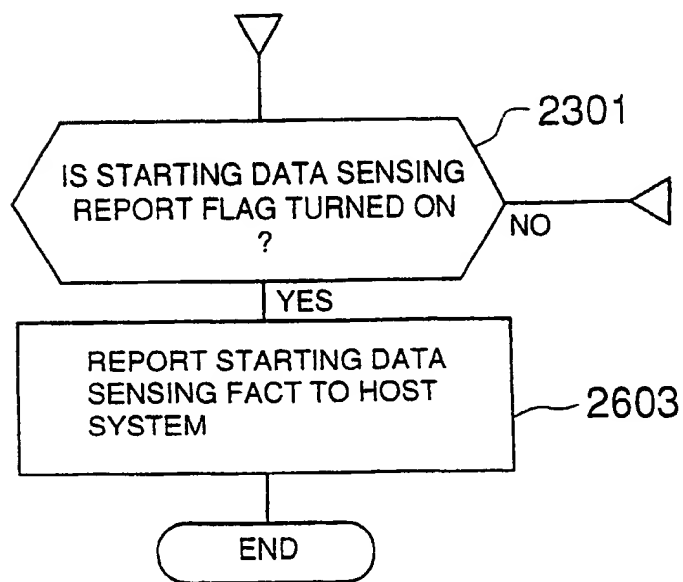


FIG. 27

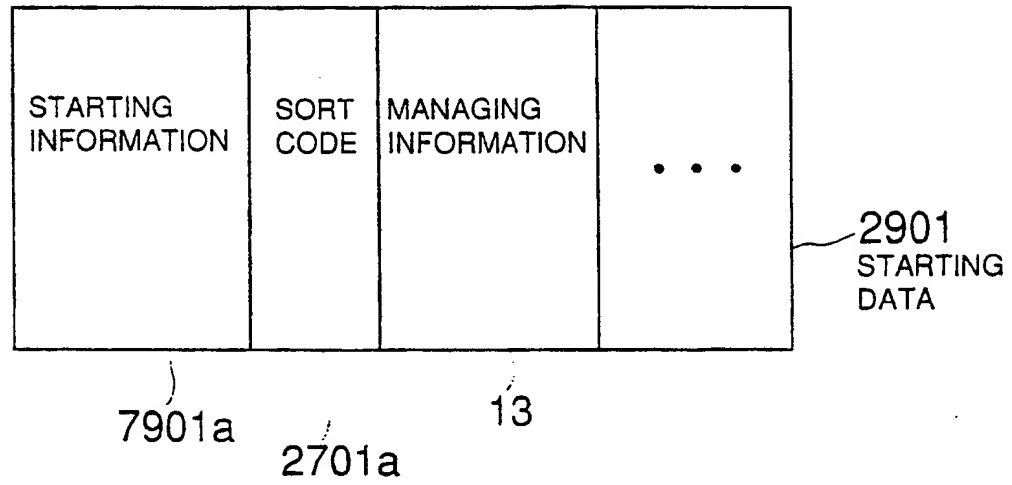
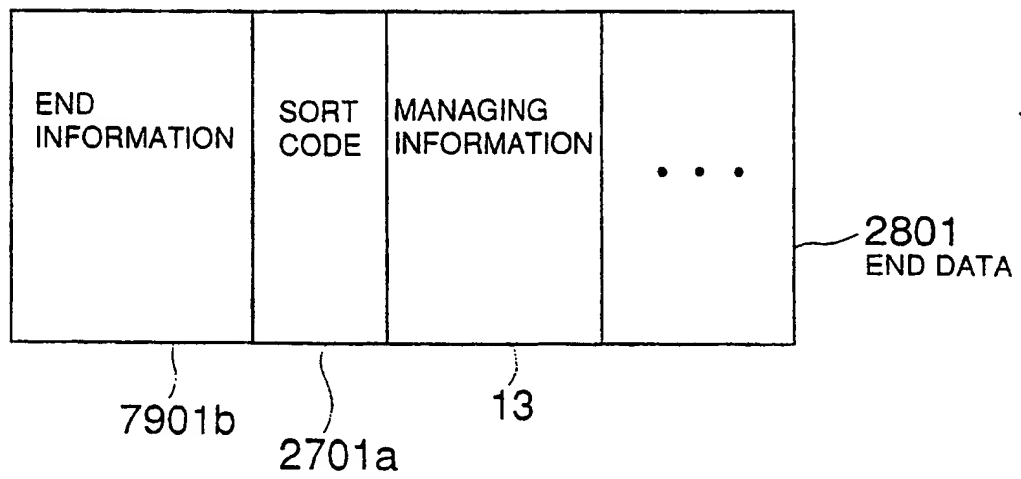


FIG. 28



STORAGE CONTROL METHOD AND APPARATUS

1

The present invention relates to a storage control method for storing data, which have been stored in a plurality of storage apparatuses, into a sequentially accessible second storage apparatus and a control apparatus therefor.

A magnetic disk apparatus, an optical disk apparatus, a magneto-optic disk apparatus, and a magnetic drum apparatus, or the like has been conventionally employed as a storage apparatus for storing data therein. To assure reliability of the data which have been stored in such a storage apparatus, there is a method for storing the same data also into another backup storage apparatus. In this case, the same data are stored in both of the original storage apparatus and the backup storage apparatus (backup purpose), i.e., the data storage operation is performed twice. Also, to achieve an effective utilization of the original storage apparatus, there is another method for saving the data into the backup storage apparatus. In any methods, the data can be restored into the original storage apparatus, if required.

For better understanding of the following explanation, storing of data into another specific storage

1 apparatus will be referred to as "archive". When a series
of data to be archived have been stored in a plurality of
storage apparatuses an archive operation will be carried
out as follows. One from among the plurality of storage
5 apparatuses in which the series of data to be saved or
archived have been stored, is selected in a data arranging
sequence (a meaningful sequence), and data within the
selected storage apparatus is saved to the specific
storage apparatus. When the archive of the series of data
10 in this specific storage apparatus have been completed, a
storage apparatus is newly selected from among the storage
apparatuses and the series of data stored therein are
archived. As described above, in a conventional method,
the series of data have been successively archived from
15 the plurality of storage apparatuses into the specific
storage apparatus.

A storage control unit of a second (another
specific) storage apparatus issues a command for perform-
ing either a data writing operation (data writing
20 operation for archiving the series of data), or a data
reading operation for a storage medium of the second
storage apparatus, to a host system (computer) which
connects a first (original) storage apparatus group
thereto, and this command is executed by the host system
25 so as to archive or restore the series of data. Thus,
although a writing or reading command for the series of
data are prepared in the second storage apparatus, no
commands to write, read or copy (overwrite) managing

1 information concerning the series of data, which are held
by the host system, have been prepared. As a result, when
the series of data are archived from the first storage
apparatuses to the second storage apparatus, the host
5 system must record and read the managing information as a
part of the data, in the prior art.

Such a sort of technical idea has been described
in, for instance, HITAC VOS 2/VOS 3 Utility 1st volume
(system utility/independent utility) 8080-3-302.

10 Furthermore, in accordance with JP-A-2-56648,
there is described that the information required for
restoring the data is prepared as the managing information
when the data are archived.

15 An object of the present invention is to provide
a storage control method capable of shortening a time
period for archive when series of data are saved or
archived from first storage apparatuses into a second
storage apparatus, which has high performance and can be
20 exclusively and sequentially accessed, and also capable of
writing managing information concerning the series of data
at a position previous to the series of data, without
repeating rewind and wind operations of a storage medium
and an apparatus therefor.

25 Such an object has been set based on the
following recognition of conventional problems.

(a). In the prior art, as previously described,

1 the data saving method is performed in such a manner that
when the series of data are saved from a plurality of
first storage apparatuses into a second storage apparatus
which is exclusively and sequentially accessible and has
5 an access speed or rate extremely faster than that of any
one of the first storage apparatuses, data is read out
from one among the plural first storage apparatuses and
then written into the second storage apparatus. After the
data have been completely saved, next data is read out
10 from a next one among the first storage apparatuses and
then are written into the second storage apparatus. As a
consequence, the time required for saving all of the
series of data depends upon only the access rate of the
first storage apparatus even if each first storage
15 apparatus has a very high access rate.

(b). If such a method would be employed wherein
the number of second storage apparatuses is prepared to be
equal to the number of first storage apparatuses and each
data are independently saved in parallel, the processing
20 speed becomes very high. However, since a plurality of
second storage apparatuses are exclusively utilized in
this method, other job service must be waited and long
time and high cost are required for managing the storage
mediums of the second storage apparatuses.

25 (c). In case that the series of data are saved
in the sequential-accessible second storage apparatus such
as a magnetic tape, when the stored data are read out to

1 be utilized, it is very convenient if managing informa-
tion (a length of each data, a storage position of the
data, a title of the data, and the number of an apparatus
in which the data has been stored) about the series of
5 data is provided at the head position of the series of
data. However, since the managing information is recorded
after the series of data have been completely written,
such managing information needs to be written after
recording the series of data and rewinding the storage
10 medium to the head position thereof. Then, in order to
subsequently use this storage apparatus, since such a
mechanical operation for winding the storage medium from
the head position thereof to the end position of the
recorded data again is required, the subsequent job must
15 be waited during this mechanical operation because the
storage apparatus cannot be used.

In addressing the above problems, the
storage control method according to the present invention
may provide (i) reading each of series of data in
20 a plurality of storage units of a first storage apparatus,
adding to the read data, an identifier for specifying one
of consecutive areas within a storage unit in which the
data have been stored, and writing the series of data
inputted from the first storage apparatus into the second
25 storage apparatus during at least one access operation and
also repeating of this writing operation.

(ii). The present invention may provide that
if an amount of data inputted from the first storage

1 apparatus is smaller than an amount of data outputted to
the second storage apparatus and the input buffers
corresponding only to the remaining data are prepared when
the respective data are read from the first storage
5 apparatus in parallel, the number of storage units of the
first storage apparatus for performing the read operation
is limited in such a way that an amount of archive data
which are read from the respective storage units per unit
time is reduced within a range of such an amount of data
10 writable within the above-described unit time.

(iii). The present invention may propose that the
identifier for specifying one of the consecutive storage
areas within each storage unit also contains a value
indicative of a sequential relation among the identifiers.

15 (iv). The present invention may also propose that
when the series of data saved into the second storage
apparatus are to be utilized, only the data having the
identifier for specifying one of the consecutive storage
areas within the first storage apparatus where the series
20 of data has been stored at first, is selected and
processed. The remaining data are once stored into the
directly accessible third storage apparatus, and after all
of the series of data saved in the second storage
apparatus have been read out, the remaining data in the
25 third storage apparatus are read into the buffer region in
an arrangement order and are processed.

(v). In a method for restoring a series of archive
data saved in the second storage apparatus to the third

1 storage apparatus, the present invention may provide
that the identifiers for specifying consecutive storage
areas of storage units in the first storage apparatus and
also the storage sizes for all the series of archive data
5 are read, new storage areas corresponding to the storage
areas and the storage sizes when a series of data corre-
sponding to the series of archive data are present in the
storage units of the first storage apparatus, are allocat-
ed to storage units in the third storage apparatus, the
10 number of which is equal to that of the storage units in
the first storage apparatus. Then, the series of archive
data read out from the second storage apparatus are
written into the storage units of the third storage
apparatus based upon the identifiers added to these data.
15 (vi). The present invention may also provide that a
series of data are saved in the second storage apparatus
in such a manner that managing information about the
overall storage areas in which the series of data have
been stored within the first storage apparatus, is added
20 just before and just after the series of saved or archive
data. A starting section constructed of at least starting
information which is for sensing a portion immediately
before the series of archive data and managing information
related to the series of archive data is recorded just
25 before the series of archive data, whereas an end section
constructed of at least end information for sensing a
portion immediately after the series of archive data and
the managing information about them is recorded just after

1 the series of archive data. When the second storage
apparatus is rewound, both the starting information and
the end information are sensed and then the end section
managing information is overwritten on the starting
5 section managing information.

(vii). The present invention may also provide that a
plurality of combinations of the starting information and
end information have been set to the storage medium of the
second storage apparatus. The end section managing
10 information about the series of archive data is stored in
correspondence with the end information. When the
starting information is sensed during the rewind operation
of the storage medium, the end information corresponding
to the sensed starting information is selected from among
15 the plurality of combinations and the managing information
corresponding to the selected end information is
overwritten on the starting section managing information.

(viii). The present invention may have the feature that
when the starting section managing information is written,
20 the overwrite suppression flag of the end section managing
information into the start section managing information is
also written. Thus, when the starting information is
sensed, a selection is made based upon this overwrite
suppression flag, whether or not the process for over-
25 writing the end section managing information is to be
performed.

(ix). The present invention may also provide that
when the starting section managing information is written,

1 a flag to determine whether or not a report for informing
sensing of the starting section is required is also
written. When the starting information is sensed, a
selection is made based on the content of this flag
5 whether or not the sensing report to a host system is to
be performed.

(x). The storage control apparatus according to the
present invention may further employ in the
main storage apparatus, a buffer region for reading the
10 series of archive data in parallel from the first storage
apparatus, and a data saving module for adding an
identifier for specifying an area for each archive data in
the first storage apparatus, to the archive data read into
the buffer region, and for writing the series of archive
15 data with the identifiers into the second storage
apparatus.

(xi). The present invention may also employ
in the main storage apparatus, a buffer region
for reading the series of archive data in parallel from
20 said first storage apparatuses a first control module for
selecting only archive data having identifiers for
specifying consecutive areas in the first storage
apparatus, where a first arrangement of the series of
archive data has been stored from among the series of
25 archive data read into said buffer region, for trans-
ferring the selected archive data to an utilization
module, and for storing the remaining archive data once
into a directly accessible third storage apparatus; and a

1 second control module for reading the archive data stored
in the third storage apparatus into the buffer region in
an arrangement sequence of the series of archive data.
(xii). Furthermore, the present invention may
5 employ in a control apparatus of the second
storage apparatus, a control module for recording a
starting section constructed of at least starting infor-
mation for sensing the starting section and managing
information and an end section constructed of at least end
10 information for sensing the end section and managing
information, and control module for reading the starting
section managing information, and for sensing both the
starting information and the end information during a
rewind operation of said second storage apparatus so as to
15 make the starting section managing information coincident
with the end section managing information.

In accordance with the present invention, (i)
the data may be parallel-written from the plural first
storage apparatuses into the second storage apparatus;
20 (ii) during this data writing operation, an identifier for
specifying an area of the first storage apparatuses is
added thereto; (iii) the managing information related to
the archive data is written into a portion immediately
after the archive data and is copied at a portion
25 immediately before the archive data during the rewind
operation; and, (iv) when the data are restored, the third
storage apparatus is allocated as the restore source, and
also the data are written into the third storage apparatus

1 based on the identifying data. As a consequence, the data
saving time can be shortened as compared to the conven-
tional data saving time. Also, the managing information
on the series of archive data can be written at the
5 portion of immediately before the data with a simple
operation, and also the waiting time for the job to
utilize the second storage apparatus can be shortened,
furthermore, when the series of archive data are utilized,
since the data are once stored in the directly accessible
10 third storage apparatus, an increase in the reading time
required for restoring the data may be prevented.

The objects and features of the invention will
best be understood from a detailed description of
15 preferred embodiments thereof, selected for purposes of
illustration and shown in the accompanying drawings, in
which:

Fig. 1 is an overall arrangement of a data
archive and restore system for showing a first embodiment
20 of the present invention;

Fig. 2 is a logic arrangement diagram of
managing information on archive data in Fig. 1;

Fig. 3 is a flowchart for representing a process
of a data archive program in Fig. 1;

25 Fig. 4 is a flowchart for explaining a process
of a data restore program in Fig. 1;

1 Fig. 5 is an overall arrangement diagram of a
data archive restore system for showing a second embodi-
ment of the present invention;

 Fig. 6 is a logic arrangement diagram of
5 starting data in Fig. 5;

 Fig. 7 is a flowchart for showing a process of a
data archive program in Fig. 5;

 Fig. 8 is a flowchart for representing a process
of a data restore program in Fig. 5;

10 Fig. 9 is an overall constructive diagram of a
data archive restore system for representing a third
embodiment of the present invention;

 Figs. 10 and 11 are logic arrangement diagrams
of starting data and end data in Fig. 9;

15 Fig. 12 is a flowchart for showing a process of
a data archive program in Fig. 9;

 Fig. 13 is a flowchart for representing a
process of a data restore program in Fig. 9;

 Fig. 14 is a constructive diagram for showing a
20 control apparatus of a data save destination storage
apparatus in Fig. 9;

 Fig. 15 is a flowchart for showing a process of
a control program in Fig. 14;

 Fig. 16 is an overall constructive diagram of a
25 data archive restore system for showing a fourth embodi-
ment of the present invention;

 Fig. 17 is a flowchart for showing a data
utilization program in Fig. 16;

1 Fig. 18 is a flowchart for representing a
process of a data read control program in Fig. 16;

 Fig. 19 is a constructive diagram of a control
apparatus for a data save destination storage apparatus
5 for showing a fifth embodiment of the present invention;

 Fig. 20 is a logic constructive diagram of a
managing information storage region within end data in
Fig. 19, and also an illustration of a storage medium of a
second storage apparatus having starting/end data on a
10 nest;

 Fig. 21 is a flowchart for showing a process of
a control program in Fig. 19;

 Fig. 22 is a logic constructive diagram of
starting data according to a modification of the third
15 embodiment shown in Fig. 9;

 Fig. 23 is a flowchart for explaining a process
of a partial addition in a modification of the control
program of Fig. 14;

 Fig. 24 is a flowchart of a partial process for
20 showing a modification of the control program in Fig. 14;

 Fig. 25 is a logic constructive diagram for
showing a modification of the starting data in Fig. 9;

 Fig. 26 is a flowchart of a partial addition
process for representing a modification of the control
25 program in Fig. 14;

 Fig. 27 is a logic constructive diagram for
showing a modification of the starting data in the fifth
embodiment of Fig. 19; and,

1 Fig. 28 is a logic constructive diagram for
representing a modification of the end data in Fig. 19.

Referring now to the drawings, preferred
5 embodiments of the present invention will be described in
detail.

Fig. 1 is a block diagram showing an overall
arrangement of a data archive (save) and restore system
according to a first preferred embodiment of the present
10 invention.

Reference numeral 1 indicates a central
processing apparatus (CPU) for controlling a main storage
apparatus and a first storage apparatus. Reference
numeral 3 indicates a main storage apparatus for storing
15 therein a program executed by CPU and data used to execute
this program. Reference numeral 7 denotes the first
storage apparatus including storage units such as magnetic
disk apparatuses, magneto-optic disk apparatuses, magnetic
tape apparatuses, or the like into which data to be saved
20 (archived) has been stored. The storage units in the
first storage apparatus correspond to files. Reference
numeral 13 represents a magnetic disk apparatus for
storing therein managing information on a series of
archive data. According to this embodiment, there are
25 provided in the main storage apparatus; a buffer area 4
for temporarily storing data; a storage region 5 for a
program for saving the data stored in the first storage

1 apparatus, and a storage region 6 for a program for
restoring this data into the first storage apparatus.

A storage apparatus for storing a series of
archive data is constructed of a control apparatus 11, a
5 second storage apparatus 8 as the destination for the
archive data; and a storage medium 9, which is typically
of a magnetic tape, for sequentially writing and reading
data. Although Fig. 1 represents that the control
apparatus 11 is arranged outside the second storage
10 apparatus 8, this control apparatus 11 may be alter-
natively built in the apparatus 8. A portion indicated by
a dot line of this figure is an enlarged view of the
magnetic tape.

For the sake of simple explanation, in a case
15 that data are saved from the first storage apparatus 7
into the second storage apparatus 8, a series of data an
amount of data per a transfer cycle which is transferred
in accordance with the data archive program 5 are
indicated by ① to ⑨. Also, the storage areas of the
20 series of data are indicated by 7a to 7i. The respective
storage areas 7a to 7c, 7d and 7e, 7f, and 7g to 7i are
represented by regions I, II, III and IV. The storage
regions I and II are present in the same storage unit.

From different point of view, the data stored in
25 the first storage apparatus will now be explained as
follows:

Each of numbers ① to ⑨ indicates data
corresponding to a data size when the data is read from or

1 written in the first storage apparatus. Accordingly, the
whole numbers ① to ⑨ represent a series of data having
a meaning. Therefore, a sequence of the numbers ①, ②,
..., ⑨ implies the series of data.

5 It is assumed that the access speed or rate of
the second storage apparatus 8 is extremely faster than
that of the first storage apparatus 7, and also the series
of data to be moved have been divided and stored into the
plurality of storage units as the first storage apparatus
10 7. In this case, this embodiment has such a feature that
the CPU 1 reads out the data stored in the first storage
apparatus 7 from these storage units in parallel, an
identifier indicative of one of the storage units in which
one of the read data has been stored is added to this read
15 data, and also the data with the identifier is stored
(saved) in the second storage apparatus 8.

As a result, since the better access performance
of the second storage apparatus 8 is available, the time
required to save the series of data may be shortened.

20 A series of archive data 900 will be written on
the storage medium 9 within the second storage apparatus 8
as follows. The data ①, ⑥ and ⑦ are read out from
the first storage apparatus 7 in parallel at a first read
operation and are stored with the identifiers I (901), III
25 (902) and IV (903) given for the respective storage
areas. Subsequently, the data ② and ⑧ are read out in
parallel at a second read operation and are similarly

1 stored with the identifiers I (901) and IV (903). Next,
the data ③ and ⑨ are read out in parallel at a third
read operation and are similarly stored with the identi-
fiers I (901) and IV (903). Then, the data ④ is read at
5 a fourth read operation and stored with the identifier II
(904). Finally, the data ⑤ is read out at a fifth read
operation and stored with the identifier II (904).

It should be noted that an identifier is
constructed of a symbol for specifying a name of any one
10 of the storage units in the first storage apparatus 7, and
also another symbol for specifying any one of the
continuous storage areas within the storage unit.

Fig. 2 represents a data storage state of a
storage apparatus for storing managing information 13 in
15 Fig. 1. As shown in Fig. 2, the managing information 13
related to the archive data is constructed of a name of a
file 1300 to be saved, and a pair of an identifier 1301
and an area size 1302 for each storage area of the storage
apparatus. Furthermore, the identifier 1301 is construct-
20 ed of name 1301a of one storage unit in the first storage
apparatus 7 and sequence number 1301b which is attached to
one of the continuous storage areas of the storage unit in
accordance with the data storage sequence (namely, a
sequence number of one of the areas within the first
25 storage unit). It should be noted that when there are a
plurality of storage areas for the series of archive data,
pairs of the identifier 1301 and the area size 1302 are

1 present in a storage sequence of the archive data.
Further, the construction of the identifier may be
modified if this modified identifier can specify the
sequence relation between the continuous storage areas and
5 the archive data.

Fig. 3 is a flowchart for explaining processing
of the data archive program in Fig. 1. In Fig. 1, to save
the data which have been separated and stored in the first
storage apparatus 7, the CPU 1 reads out and executes the
10 data archive program 5 stored in the main storage
apparatus 3.

Upon initiation of the data archive program 5,
presence, a number and a sequence of each of the
consecutive areas within the first storage apparatus are
15 obtained to determine identifiers for the consecutive
areas (a step 15). Next, a data input buffer 4 for the
respective areas is prepared (a step 17). The number of
storage units in the first storage apparatus 7 is set to a
counter N (a step 19). In case of Fig. 1, "N" is equal to
20 "3". It should be noted that a maximum value of N does
not exceed a ratio of an access rate or speed of the
second storage apparatus 8 to that of the first storage
apparatus 7.

For instance, when the access rate of the second
25 storage apparatus 8 is 10 times higher than that of the
first storage apparatus 7, the maximum value of N does not
exceed "10". It should be also noted that if the archive
data is compressed when the archive data is saved into the

1 second storage apparatus 8, the maximum value of N is to
be set, taking account of the presumed compression value.
When, for instance, the access rate ratio is 5 and the
compression ratio is $1/3$, the maximum value of N is
5 selected to be a value which does not exceed "15". In
case that the access rates of the storage units in the
first storage apparatus 7 is not equal to each other,
namely the first storage apparatus 7 contains even one
storage unit having a different access rate from those of
10 other storage units, it may be determined that a summation
of these access rates does not exceed the access rate of
the second storage apparatus 8. It is of course that if
the data amount from the CPU 1 to the second storage
apparatus 8 is smaller than that from the first storage
15 apparatus 7 to the CPU 1, the value of "N" may be selected
to be large or small, considering the memory capacity of
the buffer region 4 within the main storage apparatus 3
for storing the remaining data.

Subsequently, "1" is set to the counter I for
20 determining the sequence of storage units in the first
storage apparatus 7 (a step 21), and a check is made
whether or not there is data at a certain area within the
I-th storage unit of the first storage apparatus (a step
23). When there is no archive data, if the next value of
25 I is not greater than N, the number of I is updated by the
next value (steps 27 and 29). When there is the archive
data, since any storage unit to which an input request is
not yet issued is present in the first storage apparatus

1 7, the input request is issued for transfer in a unit of a
single block (a step 25). "1" is added to the counter I
(a step 29), and then the process returns to the step 23
at which the above-described process is repeated. It
5 should be understood that the single block implies a
transfer unit such as one cylinder unit, one track unit
and one sector unit in case of a magnetic disk apparatus.

When "1" is added and thus I becomes greater
than N (a step 27), the process is set to a waiting state
10 until the series of archive data are inputted from the
first storage apparatus 7 into the buffer region 4 (a step
31). That is, the data archive program 5 successively
issues the input requests to storage units in the first
storage apparatus 7, and judges whether or not all of
15 responses have been obtained from the storage units to
which the input requests have been issued (a step 33). If
all the responses are not yet obtained, the process
returns to the step 31 at which the waiting process is
repeated. In view of the program, a series of processes
20 as defined at the steps 25, 31 and 33 indicate such
operations that when the input requests are issued to the
storage units in the first storage apparatus 7, it waits
until all end reports (i.e., responses to the input
requests) are received, and when the end reports are
25 received from the storage units in the first storage
apparatus 7, the requested archive data have been stored
in the buffer region 4. In other words, the archive data
are read in parallel in view of the program. Although the

1 practical input operation is omitted in the drawing, it depends on channel operations.

When the responses are obtained, an identifier for specifying the storage area of each archive data is
5 added to the archive data, and then the resultant data are written into the second storage apparatus 8 (a step 35). In this case, the archive data may be compressed or may not be compressed.

Next, a check is made whether the whole archive
10 data have been saved into the second storage apparatus 8 (a step 37). If all of the archive data have not yet been saved, the process returns to the step 21 at which the subsequent process is repeated. To the contrary, when all of the archive data have been saved, the respective area
15 sizes and identifiers, and the like are registered in the managing information file 13 (a step 39). As a result, the process of this program is accomplished.

Fig. 4 is a flowchart for showing a process of a data restore program in Fig. 1. When a data restore
20 program 6 is initiated, the managing information such as the respective area sizes and identifiers is first inputted from the managing information file 13 (a step 41). Restore destination storage areas in correspondence to the number of storage areas and the storage area sizes
25 before the save operation are allocated to restore destination storage units (a step 43). In this case, the restore destination storage units may be equal to those in the first storage apparatuses 7, or in another storage

1 apparatus different from the first storage apparatus 7.
If the consecutive storage areas are assigned to the
storage units in the first storage apparatus 7 before the
save operation, they may be assigned as the restore
5 destination storage apparatus to the same storage units
but some storage areas may be combined with each other to
be assigned to an identical storage unit.

It should be noted that although managing
workload when some storage areas are combined with each
10 other is reduced, as compared to managing workload when
the storage areas are separately allocated, the writing
time is prolonged since the data writing operation is
performed in serial to a storage unit. Also, in such a
case that a plurality of consecutive storage areas are
15 present within the same storage unit in the first storage
apparatus 7 before the save operation, these consecutive
storage areas may be allocated to restore destination
storage units different from each other. In this case,
although there is no change in the writing time required
20 for restoring the archive data, since a degree of parallel
of input operations to the CPU 1 is increased when saving
the archive data again, the input time to the CPU 1 can be
shortened.

The following description will now be made of
25 such an operation that the first storage apparatus 7 is
employed. The data output buffer region 4 for each area
is prepared (a step 45). The series of archive data from
the second storage apparatus 8 are inputted (a step 47),

1 the data are stored into the buffer region 4 in corre-
spondence to the identifiers which have been added to the
data, and then data write requests are issued to the
restore destination storage units (a step 49). It should
5 be noted that when the archive data are compressed during
the data saving process, there is additionally provided a
process for expanding the compressed data.

Then, a judgement is made whether or not the
requests are issued to write any archive data among the
10 series of archive data read out from the second storage
apparatus 8 at a time, into the corresponding storage
units in the first storage apparatus 7 (a step 51). When
there is still any remaining data, the process returns to
the step 49 at which the predetermined process is
15 repeated, whereas when all the requests have been issued,
and the process is set to a waiting state until all
responses to the write requests are returned (a step 53).

A check is made whether or not all of the
responses have been returned (a step 55). If there is
20 still any remaining response, the process returns to the
step 53 at which the waiting operation is repeated. Then,
all of the responses are returned, a check is made whether
the whole archive data saved in the second storage
apparatus 8 has been entirely restored (a step 57). If
25 the restore operation has been accomplished, the process
of the restore program 6 is ended.

It is of course that all of the archive data in
each of the plural storage unit in the first storage

1 apparatus 7 may be used so as to be restored. In this
case, the consecutive storage areas are assigned to the
storage units of the first storage apparatus 7, and
another name for specifying the series of archive data may
5 be employed as a name of the file 1300 for the managing
information 13. Furthermore, the sequence numbers of the
areas within the first storage apparatus 7 may not be
specifically set, otherwise may be set to a number
indicative of a first number. Also, among the series of
10 archive data, all archive data of plural files within any
storage units in the first storage apparatus 7 may be
employed so as to be restored. At this time, a plurality
of file names 1300 and the area information thereof
constituting a plurality of managing information may be
15 set to a single managing information file 13, and also key
information for specifying the respective managing
information may be added.

As previously described, in the first
embodiment, the save operation is effected from the first
20 storage apparatus 7 to the second storage apparatus 8, and
the data restore operation is performed from the second
storage apparatus 8 to the first storage apparatus 7. In
this case, when the access rate of the second storage
apparatus 8 is extremely faster than that of the first
25 storage apparatus 7, the series of data stored in the
plurality of storage units in the first storage apparatus
7 are read out in parallel and then written into the
single second storage apparatus 8 during the data save

1 operation. During the data restore operation, the series
of data stored in the second storage apparatus 8 are read
and written into the plurality of storage units in the
first storage apparatus 7, so that both the data archive
5 and restore times may be shortened.

[Second preferred embodiment]

Fig. 5 is a block diagram for showing an overall
data archive restore system according to a second embodi-
ment of the present invention.

10 In the first embodiment, the managing infor-
mation file is required to register the managing infor-
mation related to the archive data. To the contrary, in
the second embodiment, the managing information is
registered in the second storage apparatus 8 together with
15 the archive data. As a consequence, since no workload is
required to process the managing information related to
the archive data, the operation and management for saving
or restoring the archive data may be simply performed.

The second embodiment is different from the
20 first embodiment in a data archive program 59 and a data
restore program 61 which have been stored in the main
storage apparatus 3 and archive data 6300 which have been
written into the recording medium 63 in the second storage
apparatus 8. Also, there is such a difference that
25 starting data 6301 has been added to a front portion of
the archive data 6300.

1 Fig. 6 illustrates a logic arrangement of the
starting data in Fig. 5. As shown in Fig. 6, the logic
arrangement of the starting data 6301 is data containing
at least the managing information of a series of archive
5 data. As previously stated, the managing information
includes a size of each area, an identifier and a number
of the storage area before a data save operation.

Fig. 7 is a flowchart for showing a process of
the data archive program 59 in Fig. 5. The process of
10 this data archive program 59 has the following differences
in that steps 65 and 67 are added after the step 33 and
the step 39 is substituted by steps 69 and 71, compared to
that of the first embodiment.

Only these different processes will now be
15 described and description of the same processes as those
of the first embodiment is omitted. That is, a judgement
is made whether or not the write operation into the second
storage apparatus 8 is for the first time (a step 65). If
it is the first data writing operation, the starting data
20 is written (a step 67). If the process corresponds to the
data writing operation after the first writing operation,
the process advances to the step 35 at which the archive
data are written into the second storage apparatus 8. It
should be noted that, in this case, even when the starting
25 data is to be written, if the managing information of the
series of archive data is not clarified and thus cannot be
written, only the write area or column is prepared and
kept in a blank state.

1 Next, after the save operation of all the series
of archive data has been accomplished (the step 37) and
the second storage apparatus is positioned to a place
where the starting data should be recorded (a step 69),
5 the managing information such as the sizes of storage
areas is written into the write column of the starting
data which was blanked (a step 71). When the second
storage apparatus 8 is a magnetic tape and the like, the
rewind operation is needed for the positioning purpose.

10 Fig. 8 is a flowchart for showing a process of
the data restore program 61 in Fig. 5. This data restore
program 61 has a difference, as compared to that of the
first embodiment, in that a step 73 is executed instead of
the step 41. In the first embodiment, the managing
15 information was read out from the managing information
file 13 at the beginning of the restore process. In the
process shown in Fig. 8, the managing information is read
out from the second storage apparatus 8 (a step 73).
Other processes are identical to those of the first
20 embodiment.

As previously described, in the second embodi-
ment, location information when each archive data is
present before the archive data is saved from the storage
apparatus 7, namely the managing information is recorded
25 into the storage apparatus 8 together with the series of
archive data. When the series of archive data is to be
restored, the managing information thereof is first read
out so as to perform the restore process, whereby the

1 workload for managing the series of archive data may be
reduced.

[Third preferred embodiment]

Fig. 9 is a schematic diagram for showing an
5 overall data archive restore system according to a third
embodiment of the present invention.

In the third embodiment, there are such
differences in a data archive program 75, a data restore
program 77, a construction 7900 of a series of archive
10 data written into the storage medium 79 within the second
storage apparatus 8, and a control apparatus 81 of the
second storage apparatus 8, as compared to those of the
first embodiment. That is to say, starting data 7901 and
end data 7902 have been added before and after the series
15 of archive data 7900 stored in the storage medium 9 of the
second storage apparatus 8, as compared to that of the
first embodiment.

In the second embodiment, when the managing
information related to the series of archive data is
20 recorded together with the series of archive data into the
second storage apparatus 8, there is data of the managing
information to be determined at the last operation of the
save or archive process. Therefore, after the whole
series of archive data have been saved, the storage medium
25 8 is positioned at the starting data position and
predetermined managing information is again written. To
the contrary, as shown in Fig. 9, in the third embodiment,

1 the managing information which has been written at the end
of the series of archive data is automatically reflected
onto the starting data during the rewind operation by the
control apparatus 81 of the second storage apparatus 8.
5 In other words, the managing information is written into
the end data 7902 positioned at the last part, the control
apparatus 81 previously reads the managing information
positioned at the last part while either the rewind or
wind operation is carried out so as to utilize the series
10 of archive data, and when the control apparatus 81 reaches
the starting data area, it writes the managing information
which has been additionally stored.

As a result, after the series of archive data of
a file are saved to the second storage apparatus 8, these
15 data may be continuously used for other purposes.
Accordingly, different from in the second embodiment, for
rewinding the recording medium to the starting data area,
after the last archive data has been saved, a winding
operation is not necessary for forwarding the recording
20 medium to the end position of the archive data after the
managing information is recorded. Then, since there is no
problem that the second storage apparatus 8 cannot be used
during the winding and rewinding operations, the avail-
ability of the second storage apparatus can be improved.

25 Fig. 10 is a logic constructive diagram of the
starting data in Fig. 9 and Fig. 11 is a logic construc-
tive diagram of the end data in Fig. 9. As shown in Fig.

1 10, the logic construction of the starting data 7901 is
data containing at least starting information 7901a, by
which the control apparatus 81 of the second storage
apparatus 8 can recognize the start data, and the managing
5 information 13 of the series of archive data. Also, as
shown in Fig. 11, the logic construction of the end data
7902 is data containing at least end information 7902a, by
which the control apparatus 81 can recognize the end data,
and the managing information.

10 Fig. 12 is a flowchart for representing a
process of the data archive program of Fig. 9. In the
flowchart of Fig. 12, a step 83 is added instead of the
step 63, in comparison with that of the second embodiment
shown in Fig. 7. Also, instead of the steps 69 and 71, a
15 step 85 is newly employed. That is to say, at the step 67
of the second embodiment, the managing information has
been stored in the second storage apparatus 8 as single
data similar to each archive data. To the contrary, in
the third embodiment, the managing information 13 is
20 utilized as a parameter and the writing operation of the
starting data 7901 is demanded by a command to the control
apparatus 81 (a step 83). In response to this command,
the control apparatus 81 adds at least the starting
information to the managing information 13, and then
25 writes this managing information with the starting
information into the second storage apparatus 8. It
should be noted that also in this case, data with a blank
kept is contained in the managing information, similar to

1 the second embodiment.

Also at the step 85, the managing information 13 is used as the parameter, and a request to write the end data 7902 is issued to the control apparatus 81, similar
5 to the step 83. In response to this request, the control apparatus 81 adds at least the end information to the managing information and then writes this managing information with the end information into the second storage apparatus 8.

10 Since other processes are the same as those in the second embodiment, an explanation thereof is omitted.

Fig. 13 is a flowchart for a process of the data restore program in Fig. 9. In Fig. 13, only the first step of this flowchart is different from the flowchart of
15 the second embodiment as shown in Fig. 8. That is to say, at the step 73 of the second embodiment, the managing information which has been stored as single data similar to each archive data, was inputted from the second storage apparatus 8 in response to the input request, similar to
20 the archive data. To the contrary, at the step 87 of the third embodiment, the request to input the parameter within the starting data is issued to the control apparatus 81, whereby the managing information is inputted. The remaining processes are the same as those
25 of the second embodiment.

Fig. 14 is a schematic block diagram of the control apparatus of the second storage apparatus in Fig. 9. The control apparatus 81 comprises a processor 89

1 functioning as the process apparatus therein a memory 91,
at least one read unit (reading head) 97 for reading data
from a storage medium 79 such as a magnetic tape or the
like, at least one write unit (writing head) for writing
5 data in the storage medium 79, a starting data sensing
unit 103, and an end data sensing unit 101 for similarly
sensing the end data. In the memory 91, there are
provided a control program 95 which is activated by
receiving a start request and end request for the data
10 writing operation, a request for inputting parameters in
the starting data, and furthermore a rewind demand which
are supplied from the upper system of CPU 1 or the like,
and also the archive data managing information storage
region 93 within the end data for storing the managing
15 information within the end data so as to copy (overwrite)
this information when it reaches the starting position by
rewinding the storage medium.

It should be noted that these requests may be
issued from not only the host system but also other
20 programs within the control apparatus 81. It should be
noted that a work storage region other than the storage
region 93 required for executing the control program 95
has been omitted from the drawing. Although the control
program 95 may be separated into programs for every
25 request and any one of the separated programs may be
activated in accordance with the event. In this example,
the request accompanies a symbol recognizable by a program
for specifying the sort of the request and when the

1 control program 95 is activated a desirable process is
executed in accordance with this symbol.

Fig. 15 is a flowchart for explaining a process
of the control program in Fig. 14. Upon activation of the
5 control program 95, a judgement is made whether or not an
activating purpose corresponds the request (the step 83 of
Fig. 12) for writing the starting data from the host
system (a step 105). If YES, then starting information
for sensing the starting data by the starting data sensing
10 unit 103 is added at least to the managing information
which has been added as the parameter of this request and
then written into the storage medium 79 (a step 107), and
the process of this program is accomplished. Also, if
this request is not for writing the starting data, another
15 judgement is made as to whether or not the activating
purpose corresponds to a request (the step 85 to Fig. 12)
for writing the end data from the host system (a step
109). If YES, then end information for sensing the end
data by the end data sensing unit 101 is added at least to
20 the managing information which has been added at the
parameter for this request, and thus is written into the
storage medium 79 (a step 111), so that the process of the
program is ended. If this request is not for writing the
end data, a check is made whether or not the activating
25 purpose corresponds to a request (the step 87 of Fig. 13)
for reading the starting data from the host system (a step
113). If YES, then based upon the information for
specifying archive data, the archive data is specified to

1 read this starting data, the managing information is transferred to the host system (a step 115) so that the process of this program is accomplished. If this request is not for reading the starting data, a check is made
5 whether or not the activating purpose corresponds to a request issued from the host system for rewinding the storage medium (a step 117). If YES, then the storage medium such as a magnetic tape is rewound and the process waits for a sensing report from the sensing unit 101 (a
10 step 119). Upon receipt of the sensing report, the end data is read and the managing information contained therein is stored in the storage region 93 (a step 121). Subsequently, the process waits for a sensing report issued from the sensing unit 103 (a step 123). Upon
15 receipt of the starting data sensing report, the starting data is read (a step 125) and a judgement is made whether or not the managing information on the starting data is coincident with the end data information (a step 127). If
20 YES (coincident), then the process of this program is accomplished. If NO (incoincident), then the managing information contained in the starting data within the storage medium 79 is rewritten by use of the managing information contained in the end data (a step 129) and the process of this program is accomplished.

25 When the activating purpose is not equal to the rewind request, other requests issued from the host system will be processed. However, since this process is out of the process according to the present invention, an

1 explanation thereof is omitted.

A modification according to the third will now
be described. At the step 105 of Fig. 15, as the method
for specifying archive data in order to read the starting
5 data, the following method is considered, wherein key data
(for instance, a file name and a generation number) which
has been received as a parameter of the starting data
writing request from the host system when the starting
data at the step 103 is written, is contained in the
10 starting data and written into the storage medium. At the
step 115, the key data is transferred to the sensing unit
103. When the sensing unit 103 senses the starting data,
the above-described key data is compared with the key data
contained in the starting data. If there is coincidence,
15 it can be recognized that the key data is the corre-
sponding archive data.

Alternatively, it may be recognized that every
time the sensing report is issued from the sensing unit
103, either the starting data or the archive data is read
20 so as to be analyzed, whereby the analyzed data corre-
sponds to the desirable archive data. It should be under-
stood that the request for rewinding the storage medium
has been utilized as the conventional method, and is
issued from the host system. In this case, there is only
25 a rule to first read out from, the head of a series of
archive data when the recorded archive data are read, and
no other specific rule as to the method for issuing the
rewind request at the host system and the timing of the

1 request issuance.

It is of course that at the step 127 shown in Fig. 15, without comparing the managing information within the end data with the managing information in the starting data, the managing information in the starting data may be substituted by the managing information within the end data without any condition.

Thus, as the method for storing the location information when archive data has been present in any storage unit, together with the archive data into the storage apparatus, when the storage medium is to be rewound in response to a request from the host system, since the managing information stored at the end portion of the series of archive data is automatically overwritten into the head portion of the series of archive data so that there is no need to rewind the storage medium only to store the archive data, data access to the second storage apparatus 8 by the subsequent job does not need be longer waited.

Also, when the written data is read to be utilized, if there is the managing information related to this data at the head portion of this read data, such information useful in processing this data is recorded on the tail portion thereof. There is a function to automatically overwrite this information on the head portion of this data during the rewind operation due to some objects, so that it is possible to provide the information useful for the host system and furthermore the

1 control apparatus 81 of the second storage apparatus. For
instance, there exists such a method with respect to the
control apparatus 81 that at the step 111, the positional
information, number of data and quantity of data and the
5 like are written into the storage medium together with end
data, which may be utilized while reading the recorded
data, writing another data on the recorded data, and
additionally writing another data thereon.

Furthermore, in order that the data stored in
10 the storage medium will pass through the at least one
reading unit 97 prior to the writing unit 99 in the
control apparatus 81 during the rewinding operation of the
storage medium 79, both the end data and the starting data
are sensed via the reading unit 97, a comparison is made
15 between the end data and at least a portion of the
starting data before the starting data has passed through
the writing unit 99. If the comparison result is
incoincident, the at least a portion of the starting data
can be written, the reading unit 97 is physically
20 separated from the writing unit 99, and the storage
apparatus controls the rewind speed and also the control
program is executed. As a consequence, neither the
winding operation is required, nor the rewinding operation
is stopped during the rewinding operation in order to
25 process that the end data is reflected to the starting
data.

Fig. 22 represents a modification of the
starting data in the third embodiment. Fig. 23 is a

1 flowchart for showing the modification partially changed
from the flowchart of Fig. 15. Fig. 24 is a flowchart for
processing the modification added to the preferred
embodiment of Fig. 15.

5 As shown in Fig. 22, an instruction parameter
for suppressing a non-condition writing operation of the
end data is provided for the request for writing the
starting data, and also a non-condition writing suppress
flag 2201a is provided in the starting data 2201a. The
10 flag within the starting data is turned on at the step 107
of Fig. 15 and then written into the storage medium 79,
and a step 2301 is newly provided between the steps 125
and 127, at which a check is made whether or not the
non-condition writing suppress flag is turned on, as shown
15 in Fig. 23. If this flag is turned on, a control is made
to suppress for overwriting the end data, and updating of
the managing information within the starting data may be
performed by updating the starting data. At this time, as
a result of judgement whether or not the rewind request is
20 issued at the step 117 of Fig. 15. If No, then the
process as represented in Fig. 24 is added to the control
program 95. That is to say, as shown in Fig. 24, if there
is a request for updating the starting data at a step
2401, based on the information for specifying the archive
25 data which has been designated as the request parameter
from the host system, for instance, the file name and
generation number thereof, the archive data within the
storage medium 79 is specified (a step 2403). Then, the

1 managing information 13 within the starting information is
updated in accordance with the instruction given from the
host system (a step 2405). If there is a non-condition
write flag on request (a step 2407), the archive data
5 within the storage medium 79 is specified (a step 2403)
and this flag is turned on (a step 2409). Also, if there
is a non-condition write flag off request (a step 2411),
the archive data in the storage medium 79 is specified (a
step 2403) and this flag is turned off (a step 2413).

10 Fig. 25 is a format diagram of the starting data
for representing another modification of the third
embodiment. Fig. 26 is a flowchart made by partially
modifying a portion of the flowchart shown in Fig. 15.

When in response to the starting data writing
15 request, the starting data is sensed, the designating
parameter for reporting this fact to the request source is
provided, as shown in Fig. 25, a starting data sensing
report flag 2501a is employed within the starting data
2501, the flag within the starting data is turned on at
20 the step 107 of Fig. 15, whereby this starting data is
written into the storage medium 79, and further the
process as defined in Fig. 26 is interposed between the
steps 125 and 127. In other words, a step 2601 is
employed at which a check is made whether or not the
25 starting data sensing report flag 2501a within the
starting data is turned on. If this flag is turned off,
the processes defined after the step 127 are executed. To
the contrary, if this flag is turned on, it is so

1 controlled that sensing the starting data is reported to
the host system (a step 2603), and the updating operation
of the managing information within the starting data may
be performed as in the steps 2401, 2403 and 2405 of Fig.
5 24. Also, when the starting data is sensed and reported,
this sensing operation may be reported together with the
managing information within the end data which has been
stored at the step 121 of Fig. 15.

Also, a plurality of parameters of the requests
10 for writing the starting data by which the managing
information is given within the starting data may be
designated and the overwriting of the managing informa-
tion in the end data can be suppressed and also the
starting data sensing report can be designated by the
15 parameters. As a result, both the method for automa-
tically copying the end data, and the method for updating
the starting data can be selectively utilized based upon
intentions of users for the managing information within
the starting data, so that more effective services can be
20 provided.

[Fourth preferred embodiment]

Fig. 16 is a block diagram of an overall data
archive restore system according to a fourth embodiment of
the present invention.

25 The first, second and third embodiments related
to the data save operation, and the fourth embodiment has
such a feature in a method for restoring data in a case

1 that the archive data are read out and immediately
utilized.

As shown in Fig. 16, in accordance with the
fourth embodiment, basic arrangements thereof are the same
5 as the data archive program 75, the control apparatus 81
of the second storage apparatus, and the arrangement 7900
of the archive data as described in the third embodiment.
It should be noted that even when the data saving methods
based on the first and second embodiments are employed,
10 the data archive restore system according to the present
invention may be realized.

In the fourth embodiment, there are newly
required as new constructive elements, a data utilization
program 131 to utilize data to be saved; an archive data
15 read control program 133 for controlling read operation of
the archive data; and a third storage apparatus 135 for
temporarily storing the data read from the second storage
apparatus. Other constructive elements are identical to
those of the third embodiment.

20 In this embodiment, with respect to the parallel
sequence of the data, data ① to ⑤ of the storage
apparatus into which the head data has been stored are
immediately utilized once these data are read out from the
second storage apparatus 8. The data ⑥ to ⑨ which
25 have been stored in the first storage apparatus 7 are once
written into either the first storage apparatus 7, or
third storage apparatus 135 directly accessible. Next,
after all of the archive data have been read out from the

1 second storage apparatus 8, the process to read the
archive data is controlled in such a manner that the data
are read out from either the first storage apparatus 7, or
the third storage apparatus 135. As a consequence, the
5 storage medium within the second storage apparatus 8 is
rewound at each of the first storage apparatuses 7 to
which the data have been saved, and an increase in the
read time required for reading the save data may be
prevented.

10 Fig. 17 is a flowchart for explaining a process
of the data utilization program in Fig. 16. As repre-
sented in Fig. 17, a content of a process for the data
utilization program 131 is as follows. Upon initiation
necessary data is read via an archive data read control
15 program 133 (a step 137). A check is made whether the
data is deleted (a step 139). If there is no data, then
the process of this data utilization program 131 is
accomplished. To the contrary, if the data still remains,
after the read data has been utilized (a step 141), a
20 judgement is made whether or not the data still needs to
be inputted (a step 143). If YES, the processes as
defined after the step 137 are repeatedly performed,
whereas if no data input is required, then the process for
the data utilization program 131 is ended.

25 Fig. 18 is a flowchart for representing a
process of the archive data read control program in Fig.
16. Once the archive data read control program 133 is
initiated, at first, desired data which has been stored in

1 the first storage apparatus 7 is saved into the second
storage apparatus 8, so that it is confirmed that no
desired data is present in the first storage apparatus 7
at this stage (a step 145). In case that the desired data
5 is present in the first storage apparatus 7, since the
data to be processed is not saved, the data is read out
from the first storage apparatus 7 (a step 157) and the
read data is transferred to the data requesting source
(utilization program and the like) (a step 153). When no
10 desired data is present in the first storage apparatus 7,
a check is made whether or not all of the archive data
have been read out from the second storage apparatus 8 (a
step 147). This indicate that data to be immediately
utilized are read in the buffer region 4 of the main
15 storage apparatus 3 and data to be not immediately
utilized are read from the second storage apparatus into
the third storage apparatus. As a consequence, if all of
the desired data have been read, another check is made
whether or not all of the desired data have been further
20 read out from the third storage apparatus 135 (a step
159). Also, in such a case where all of the desired data
have not yet been read from the second storage apparatus
8, namely any desired data still remain in the second
storage apparatus 8, the archive data are read out from
25 the second storage apparatus 8 (a step 149). The read
data are stored in the buffer region 4 of the main storage
apparatus 3. Subsequently, a judgement is made whether or
not the read data is present in the storage unit, in which

1 data at the head the data sequence has been stored, among
the storage units of the first storage apparatus, based on
the identifier of the read data (a step 151). In other
words, confirmation is made whether or not the read data
5 corresponds to the data ① to ⑤ which should be
immediately utilized. If the read data is not such
immediately used data, since the read data corresponds to
data which is not utilized, after the read data is written
into the third storage apparatus 135 (a step 155), the
10 process returns to a step 147 so that the above-described
process is repeated. It should be noted that no storage
unit in the first storage apparatus to which the data is
saved is employed, and alternatively the main storage
apparatus 3, an expandable storage apparatus or the third
15 storage apparatus such as other external storage apparatus
may be utilized.

In case that the data ① to ⑤ has been
present in the head storage unit of the first storage
apparatus 7, the read data is transferred to the request-
20 ing source (a step 153) so that the process of the archive
data read control program 133 is accomplished. It should
be noted that when all of the archive data which have been
temporarily written in the third storage apparatus 135 are
read out, since all of the read data have been stored into
25 the buffer region 4 of the main storage apparatus 3, the
process of the archive data read control program 133 is
ended. If a portion of the read data still remains
therein, after the data is read out from the third storage

1 apparatus (a step 161), the read data is transferred to
the data requesting source (a step 153).

It should be noted that both utilizing the
archive data by way of the data utilization program 131
5 and restoring the archive data to the third storage
apparatus 135 can be simultaneously carried out. At this
time, it is of course that as to the data which have been
stored at the head storage unit in the first storage
apparatus 7, the process for writing the data into the
10 third storage apparatus 135 corresponding to the step 155
is added to the step 153.

At the step 155, when the data is written into
the third storage apparatus 135, the method for allocating
the storage units of the first storage apparatus 7 to
15 store this data may be based on the same number of areas
and the same size as those before the save operation, a
group of areas, or the smaller number of areas.

Thus, in case that the archive data are read out
and immediately utilized, when the data ① to ⑤ within
20 the head one with respect to the parallel sequence of the
data, among the storage units of the first storage
apparatus 7 to which the data area saved, are read out
from the second storage apparatus 8, these data are
immediately utilized, whereas the data ⑥ to ⑨ which
25 have been stored in the first storage apparatus 7 are once
reserved in the directly accessible third storage
apparatus 135, and the reserved data are read out so as to
be utilized after all of the archive data have been read

1 out from the second storage apparatus 8. As a result, an
increase in a read time required for rewinding the storage
medium within the second storage apparatus 8 for each
storage unit of the first storage apparatus 7.

5 [Fifth preferred embodiment]

Fig. 19 is an internal constructive diagram of
the control apparatus in the second storage apparatus
according to a fifth embodiment of the present invention.
Fig. 20 is a logic constructive arrangement of a managing
10 information storage region in end data according to the
fifth embodiment. Fig. 21 is a flowchart for showing a
process of the control program in Fig. 19. Figs. 27 and
28 are logic constructive diagrams of starting data and
end data in the fifth embodiment. It should be noted that
15 since the overall constructive arrangement is arranged
such that the control apparatus 163 and the arrangements
of the starting data and end data in the storage medium 79
in the second storage apparatus are different from those
of the third embodiment, but other constructions are the
20 same as those of the third embodiment, a drawing thereof
is omitted.

In the third embodiment, only one combination
between the starting information and the end information is
assumed. To the contrary, there is a different point in
25 preparation of several sorts of combinations between the
starting information and the end information. That is to
say, the managing information in the end data every sort

1 of the end information, is stored. If the starting
information is sensed, a control is so carried out that
the managing information of the end information corre-
sponding to this starting information is written into the
5 starting data. As a result, plural sorts of data
sandwiched between starting information and end infor-
mation can be recorded. In other words, either the host
system or the control apparatus can store more than one
combination of certain data and managing information, and
10 furthermore the managing information related to the
overall combinations can be stored.

The fifth preferred embodiment will now be
described in detail. As represented in Fig. 19, the
control apparatus 163 of the second storage apparatus has
15 the following different constructions, as compared to
those of the third embodiment, of a managing information
storage region 165 in end data and a control apparatus
163. Also, the function of the control apparatus 163 has
such a different point, as compared to the function
20 thereof according to the third embodiment, in that when
request for writing starting data and a request for
writing end data are issued, a parameter indicative of
this sort can be designated. It should be noted that this
request may be issued from the host system and/or from
25 another program in the control apparatus 163, similar to
the third embodiment.

As indicated in Fig. 20a, the logic constructive

1 arrangement of the managing information storage region 165
within the end data is constituted by a sort code 7902 and
managing information 13. These sort code and managing
information are combined to be stored, depending upon
5 sorts of the sort codes.

Fig. 20b illustrates a storing method to store
plural sorts of managing information into the second
storage apparatus. With respect to the storage medium of
the second storage apparatus, a combination of starting
10 data 2701 and end data 2801 is provided for the whole of a
series of archive data, and there are combinations between
starting data 790a, 791a, 792a, ..., and corresponding end
data 790b, 791b, 792b, ..., for every block. As this
block, a unit of cylinder, track and sector may be
15 utilized. In this case, the managing information storage
region 165 in the end data is subdivided into a region for
writing therein entire managing information and regions
for writing therein managing information of the respective
archive data 7a, 7f, 7g and 7e and so on. As previously
20 stated, in case that the sorts of the starting data and
end data are nested, the sort codes are required. After
the end data is read every block data, and stored in the
storage region, both the starting data and end data must
be correctly written at the starting data position of the
25 block corresponding to that when the rewind operation is
performed.

As shown in Figs. 27 and 28, both starting data
2701 and end data 2801 contain sort codes indicative of

1 the respective sorts thereof. In other words, the
starting data 2701 is constructed of starting information
7901a, a sort code 2701a, and save data managing data.
Also, the end data 2801 is constructed of end information
5 7901b, a sort code 2701a and save data managing informa-
tion 13.

As shown in Fig. 31, a process of the control
program 167 has the following different points from those
of the third embodiment. That is, instead of the step 107
10 of Fig. 15, when a demand to write the starting data is
issued, the sort code 2701a instructed as a parameter of
the request is added to the managing information, which
are then written into the storage medium 79 (a step 169).
Similarly, instead of the step 111, when a request for
15 writing the end data is issued, a sort code 281a
designated as a parameter of this request is added to the
managing information 13, which are then written into the
storage medium 79 (a step 171).

Also, instead of the step 121 shown in Fig. 15,
20 the end data is read and both the sort code contained
therein and the managing information are written into the
managing information storage region 165 within the end
data (a step 173).

To select the managing information 13 written
25 into the starting data, the managing information within
the managing information storage region 165 in the end
data is obtained in which the sort code 2701a within the

1 starting data which has been read at a step 125 is
coincident with the sort code 7902 in the managing
information region 165 within the end data (a step 175).

As previously described, since plural sorts of
5 the starting data and end data may be provided, the
managing information related to the overall storage data
and the managing information about the data on a portion
of the storage data may be set in accordance with their
purposes.

10 After all, the present invention owns the
following features.

(a). In case that the data is saved to the same
second storage apparatus which is exclusively and
sequentially accessed, and the access rate of which is
15 considerably higher than that of the first storage
apparatus to which the data is saved, when the save data
have been separated and stored in a plurality of first
storage apparatuses, the data stored in the storage units
of the first storage apparatus are parallel-read out from
20 the respective storage units, the identifiers for
specifying the data within the respective storage units
are added to the read data, and the resultant data are
stored in the same second storage apparatus, whereby the
higher access rate of the second storage apparatus may be
25 utilized so as to shorten the data save time.

(b). Since the location information(managing
information) about the save data which has been saved in

1 the first storage apparatus is stored together with the
save data into the second storage apparatus, and therefore
the managing load of the managing information related to
the save data is eliminated, both the operations and
5 managements required for saving and restoring the data may
be simplified.

(c). When as the managing information related
to the save data, no decision is made that it is not the
last of the save process, the managing information is
10 written into the last of the data, the control apparatus
of the second storage apparatus automatically reflects to
the managing information of the data at the head position
thereof during the rewind operation. As a consequence,
even when the second storage apparatus is continuously
15 used for other purposes, such an operation that after the
data is written, the second storage apparatus is rewound
to the head position of the data and further wound to the
data end is no longer required to save the data. During
this time period, since there is no case that the second
20 storage apparatus cannot be used, the possibilities of the
apparatuses may be improved.

(d). Since the control is carried out during
the rewinding operation of the storage medium in such a
manner that the head portion of the data is sensed before
25 this head portion passes through the writing portion, and
the managing information present at the data end is
written into this head portion, the rewinding operation of
the storage apparatus for this information overwrite

1 needs not be stopped and thus the rewinding time is not prolonged.

(e). Also, since the control is performed in such a manner that the overwrite of the managing
5 information present at the data end on the head position without any restriction is suppressed, and when the head position of the data is sensed, this sensing fact is reported to the requesting source, both the method for automatically overwriting the managing information of the
10 data end, and the method for updating the managing information of the head portion of the data in accordance with the intentions of the user for the managing information may be properly selected, so that the better services can be effectively provided.

15 As previously explained, according to the present invention, since when the data is saved from the storage unit of the first storage apparatuses to the second storage apparatus which is exclusively and sequentially accessed and has the very higher access speed or
20 rate than that of each of the storage units, the data are parallel-inputted from the storage units thereinto, the save time can be shortened. Also, in case that the managing information of the archive data is arranged at the head position of the archive data, as the managing
25 information is written into the last portion thereof during the data save operation, and also this managing information is automatically copied at the head portion of this data during the rewind operation, rewinding and

- 1 winding the storage medium are not repeatedly performed and the managing information on the storage data may be set at the head position of the data.

CLAIMS:

1. A storage control method by a computer including a buffer for saving a series of data into a second storage apparatus, which are separated and stored into a plurality of first storage apparatuses in such a manner that a portion of the data is stored into a certain storage apparatus of said first storage apparatuses, and a portion of data subsequent to said portion of the data is stored into other storage apparatuses of said first storage apparatuses, comprising the steps of:

(a). reading said series of data which have been stored into said plurality of first storage apparatuses, into said buffer in a parallel mode from each of said plural first storage apparatuses by a predetermined data size;

(b). adding to each of said data with a predetermined data size read into said buffer, an identifier for specifying a storage position within said plural first storage apparatuses to which said data have been stored;

(c). sequentially storing the data added with said identifier and stored in said buffer, into said second storage apparatus; and,

(d). repeating the steps defined from said step (a) to said step (c) until said series of data have been completely stored into said second storage apparatus.

2. A storage control method according to claim 1, wherein an amount of the data read into said buffer by way

of said step (a) is smaller than an amount of the data which can be stored within a predetermined time by executing said step (c) one time.

3. A storage control method according to claim 1, wherein said identifier contains information representative of a sequential relationship in said series of data.

4. A storage control method according to claim 1, further comprising the steps of, in order to restore said series of data:

(e). reading into said buffer, said data which have been stored into said second storage apparatus and have said identifier which indicates the first storage portion within said plurality of first storage apparatuses;

(f). storing into a third storage apparatus, data other than said data having said predetermined data size at the head position of said series of data which have been stored into said second storage apparatus; and,

(g). storing the data stored in said third storage apparatus into said buffer in the arranging sequence of said series of data stored in said first storage apparatuses with reference to said identifier added to each of the data having said predetermined data size.

5. A storage control method according to claim 4, wherein in said step (f), the data other than the data having said predetermined data size at the head position of said series of data stored into said second storage apparatus, is stored into said third storage apparatus in

the arranging sequence of said series of data stored in said first storage apparatuses by referring to said identifier attached to each of said data having said predetermined data size.

6. A storage control method according to claim 1, wherein information representative of each of head and last portions of said series of data is added to each of the head and last portions of said series of data stored in said second storage apparatus.

7. In a data save and restore system including a plurality of first storage apparatuses, a second storage apparatus having an access performance higher than that of said first storage apparatuses and prepared for saving data which have been separated and stored into said first storage apparatuses, a CPU for controlling said first and second storage apparatuses, and a main storage apparatus connected to said CPU, a storage control apparatus characterized in that there are provided in said main storage apparatus;

a buffer region for reading therein in a parallel mode save data from said first storage apparatus; and,

data saving means for adding an identifier for specifying a region within said first storage apparatuses into which the save data has been stored, to the save data read into said buffer region, and for writing the save data with the identifier into said second storage apparatus.

8. In a data save and restore system including a plurality of first storage apparatuses, a second storage apparatus having an access performance higher than that of said first storage apparatuses and prepared for save data which have been separated and stored into said first storage apparatuses; a CPU for controlling said first and second storage apparatuses; and a main storage apparatus connected to said CPU, a storage control apparatus characterized in that there are provided in said main storage apparatus;

a buffer region for reading therein in a parallel mode save data from said second storage apparatus;

a control module for selecting only data corresponding to an identifier for specifying a consecutive region within said first storage apparatus, into which a first arrangement of save data has been stored, among the save data read into said buffer region, for transferring said selected data to an utilization module in a data read request from the utilization module, and for storing the remaining data once into a directly accessible third storage apparatus; and,

a control module for reading the data stored in said third storage apparatus into said buffer region in an arrangement sequence of the data.

9. In a data save and restore system including a plurality of first storage apparatuses, a second storage apparatus having an access performance higher than that of said first storage apparatuses and prepared for save

data which have been separated and stored into said first storage apparatuses; and, a control apparatus for controlling said second storage apparatus, a storage control apparatus characterized in that there are provided in the control apparatus for said second storage apparatus;

a control module for recording both a starting part constructed of starting information to sense at least an immediately front part of the data in said second storage apparatus on said immediately front part, and end information to sense at least an immediately end part on said immediately end part; and,

a second module for reading the managing information within said starting part, and for sensing both the starting information and the end information during a rewind operation of said second storage apparatus so as to make the managing information within said starting part coincident with the managing information within said end part.

10. A storage control method by a computer including a buffer for saving several series of data into a second storage apparatus, which are stored into a first storage apparatus, comprising of:

(a). reading said several series of data which have been stored into said first storage apparatus, into said buffer from said first storage apparatus by a predetermined data size,

(b). adding to the head portion of said each series of data read into said buffer, starting information

which contains at least identifier for specifying said series of data from other series of data;

(c). adding to each of data read into said buffer, each identifier for specifying said series of data from other series of data and storing said data added with said information into said second storage apparatus;

(d). sequentially storing said several data added with said identifier and stored in said buffer, into said second storage apparatus;

(e). repeating the steps defined said step (a), (c) and (d) until said several series of data have been completely stored into said second storage apparatus; and,

(f). adding to the last portions of said each series of data read into said buffer, end information which contains at least identifier for specifying said series of data from other series of data and storing said data added with said information into said second storage apparatus.

11. A storage control method according to claim 10, wherein

in said step (b), adding to the head portion of said several series of data read said buffer, totally starting information which contains at least identifiers for specifying said several series of data in addition to said starting information and storing said data added with said information into said second storage apparatus; and

in said step (f), adding to the end portion of said several series of data read said buffer, totally

end information which contains at least identifiers for specifying said several series of data in addition to said starting information and storing said data added with said informations into said second storage apparatus.

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